Part One

THE PREDICATE

Lesson 1

ГРАММАТИКА: Определение сказуемого в предложении. Простое сказуемое в действительном залоге (Indefinite). Употребление глагола *will* для выражения регулярности действия в настоящем времени, глаголов *used to* и *would* — для выражения повторности в прошлом. Функции глагола *do*.

Section I

Ex. 1. Pronounce the following words:

a)

a	[eɪ]	state, same, name, late, make, place, plane, take, face, nature, statement, correlate
a	[æ]	that, fact, back, bad, hand, land, man, plan, stand, factory, angle, happen
ar, ar + согласная	[ɑ:]	part, arm, car, dark, far, hard, large, March, start, argue, argument
ar + гласная	[eə]	care, bare, parents, vary, various
ai, ay	[eɪ]	day, train, explain, play, May, pay, say, way

b) hypothesis [haɪ'pɒθəsɪs], theory ['θɪərɪ], law [lɔ:], subject [səb'dʒekt], agree [ə'gri:], atom ['ætəm], atomic [ə'tɒmɪk], universe ['ju:nɪvɜ:s], example [ɪg'zɑ:mpl], chemist ['kemɪst]

Ex. 2. Read the following words and say what Russian words help to understand their meaning:

theory, hypothesis, correlate, test, deduction, result, experiment, atom, nature, crystal, substance, regular, interpret, systematic, argument, structure

Ex. 3. Pay attention to the following way of word-building:

основа слова + *-al* → прилагательное international, central, theoretical, hypothetical, experimental, industrial, formal, natural
прилагательное + *-ly* → наречие usually, readily, quickly, slowly, usefully, highly, easily, really, experimentally
основа слова + *-ist* [ist] → существительное, прилагательное communist, scientist, chemist, socialist, capitalist, naturalist, physicist, economist **Which of these words may be nouns and adjectives?**

Ex. 4. What part of speech does each of these abbreviations stand for: *a, adv, attr, cj, int, n, num, part, prep, pron, v*? What part of speech do the following words belong to? Write corresponding abbreviations for them.

theory, find, further, it, and, of, if, such, usually, about, part, represent, that, we, various, between, value, pure, crystal, atom, other, word, two, knowledge, by, thus, but, explain

Ex. 5. Define what parts of speech the italicized words belong to.

1. The girl's *face* was beautiful. 2. Many difficulties *face* us when we study. 3. Experimentally *means* during the experiment. 4. There are various *means* of getting substances. 5. Chemistry is a very interesting *subject*. 6. When we want to learn more about a substance, we *subject* it to study. 7. When you are not sure that your result is right, *check* it *up*. 8. During the *check* he found a bad mistake. 9. This *part* of the work is the most difficult one. 10. They *parted* in 1985 when she went to Moscow. 11. In crystals the atoms are in a regular *order*. 12. The director *ordered* him to come at once. 13. We *measure* weight by grams, kilograms, tons, etc. 14. A kilogram is a weight *measure*.

Text 1 A

Hypotheses, Theories and Laws

When we find that an idea explains or correlates a number of facts, we call this idea a hypothesis. We can subject it to further tests and to experimental checking of deductions. If the hypothesis continues to agree with the results of experiment, we call it a theory or a law.

A theory, such as the atomic theory, usually involves some idea about the nature of some part of the Universe, a law represents a summarizing statement about observed experimental facts. For example, there is a law of the constancy of the angles between the faces of crystals. The law states that whenever we measure the angles between corresponding faces of

various crystals of a pure substance, they will have the same value. It does not explain the fact. We find an explanation of the fact in the atomic theory of crystals, the theory that in crystals the atoms are in a regular order.

Chemists and other scientists use the word "theory" in two different senses. The first meaning of the word is the meaning described above — namely, a hypothesis that has been verified. The second use of the word "theory" is to represent a systematic body of knowledge, compounded of facts, laws, theories, deductive arguments and so on.

Thus, by the atomic theory we mean not only the idea that substances consist of atoms, but also all the facts about substances that can be explained and interpreted in terms of atoms and the arguments that explain the properties of substances in terms of their atomic structure.

Words and Word-Combinations to Be Memorized

also, angle, atom, atomic, body, check, consist of, correspond, crystal, example, for example, experiment, fact, further, hypothesis (hypotheses), idea, involve, in terms of, law, measure, namely, not only... but, observe, order, represent, result, same, state, statement, subject, such, test, theory, thus, universe, usually, various, verify, whenever

Ex. 6. Give the Russian equivalents for the following:

find, a number of facts, idea, subject to, experimental checking, agree with smth. (smb.), such as, the atomic theory, usually, involve, law, represent, for example, the faces of crystals, state, whenever, a pure substance, the same value, explain, in a regular order, in a sense, the meaning of the word, above, namely, verify a hypothesis, a body of knowledge, and so on, thus, not only... but, in terms of

Ex. 7. Give the English equivalents for the following:

объяснить факт, ряд экспериментов, подвергуть гипотезу проверке, экспериментальное подтверждение, согласовываться с результатами, называть законом, атомная теория, такой как, обычно, включать в себя, вселенная, утверждение, например, угол между гранями кристалла, измерять, различные вещества, то же самое значение, описанный выше, и так далее, таким образом, не только... но и, с точки зрения

Ex. 8. Fill in the blanks with prepositions where necessary.

of, to, with, for, in, by, in terms of

1. If an idea explains or correlates a number ... facts, we call it a hypothesis. 2. Scientists subject the idea ... experimental checking. 3. If the hypothesis agrees ... the results ... experiment, we call it ... a theory or ... a law. 4. ... example, everybody knows the periodic law. 5. The explanation ... the fact is ... the atomic theory. 6. ... crystals the atoms are

... a regular order. 7. ... the atomic theory we mean that substances consist ... atoms. 8. Scientists explain facts ... atoms and their structure.

Ex. 9. Practise the numerals.

a) 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 100, 1,000

b) Суффикс *-teen* образует числительные от 13 до 19, всегда ударный. Иногда при добавлении суффикса происходят изменения основы слова.

Model: 14 — fourteen

Исключения: 13 — th*ir*teen
15 — f*if*teen

13, 14, 15, 16, 17, 18, 19

c) Суффикс *-ty* служит для образования десятков, неударный.

Model: 60 — sixty

Исключения: 20 — *tw*enty
30 — th*ir*ty
40 — f*or*ty
50 — f*if*ty

20, 30, 40, 50, 60, 70, 80, 90

d) Сложные числительные.

Model: 21 — twenty-one
2432 — two thousand four hundred and thirty-two

23, 46, 34, 27, 93, 62, 87, 55, 71, 953, 281, 450, 374, 799, 543, 827, 665, 1946, 5812, 2432, 7250,1240, 9824, 7561

e) Суффикс *-th* служит для образования порядковых числительных.

Model: four — fourth

Исключения: 1-й — first
2-й — second
3-й — third
5-й — f*if*th

5-й, 6-й, 7-й, 8-й, 9-й, 10-й; 56-й, 73-й, 89-й, 94-й, 25-й, 63-й; 914-й, 852-й, 263-й, 427-й, 791-й; 2406-й, 1433-й, 5813-й, 4743-й, 3585-й

f) Числительные, обозначающие даты.

Model: до 2000-го года: 1946 — nineteen forty-six; 2000-й год: two thousand; после 2001-го года: 2004 — two thousand and four

1945, 1917, 1812, 1799, 1242, 1961, 1957, 1825, 2001, 2003, 2005

Ex. 10. a) Read the following forms of the verbs; mind different ways of reading *-s* and *-ed*.

explains, correlates, continues, calls, involves, states, uses, verifies, means; called, subjected, checked, involved, represented, observed, corresponded, used, described, consisted

b) Give the three forms of the following verbs:

be, have, find, do, mean, give

c) Translate the sentences into Russian.

1. A theory usually involves some idea about the nature of some part of the Universe. 2. The periodic law represents a summarizing statement about the properties of elements. 3. The scientists verified the hypothesis and it became a theory. 4. A law will not explain the fact, it only states the fact. 5. Early scientists would use the word "theory" in two different senses, now we do the same. 6. A hypothesis usually explains or correlates a number of facts. 7. Now we are speaking about hypotheses, theories and laws. 8. The atomic theory explains and interprets the facts in terms of atoms. 9. A good theory will live a long life. 10. Will you tell us what you know about a hypothesis? 11. What do we call a law? 12. Early scientists did not think of atoms. 13. Now the atomic theory is more popular than it used to be. 14. Before the nineteenth century chemists would not think about families of elements. 15. The periodic law does help chemists in their work. 16. Have you translated the sentences about the atomic theory? 17. By the atomic theory of crystals the atoms in them will be in a regular order.

Ex. 11. Translate the following sentences into English:

1. Закон — это такое утверждение, которое суммирует наблюдаемые экспериментальные факты. 2. Теория дает экспериментально подтвержденное объяснение фактов. 3. Вы поняли, что такое гипотеза? — Да, это идея, которая объясняет или сопоставляет ряд фактов. 4. Когда эксперименты действительно подтверждают какую-то гипотезу, мы обычно называем ее теорией. 5. Ученые знают много гипотез, которые стали теориями или законами. 6. Химики широко пользуются атомной теорией. 7. Древние ученые думали о структуре веществ. 8. Мы объясняем свойства веществ с точки зрения их атомной структуры.

Ex. 12. Make up questions to the italicized parts of the sentences.

1. *Chemists* use the word *theory* in *two* different senses (3)*. 2. We usually *subject a hypothesis* to further tests (2). 3. *Every science* has *its* laws (2).

Ex. 13. Answer the following questions:

1. What is a hypothesis? 2. Do you know what a law is? 3. Do you know any laws? 4. What is a theory? 5. What theories do chemists use in their work? 6. What do we mean by the atomic theory? 7. When did you hear about the atomic theory for the first time?

Section II

Упр. 1. Прочтите заглавие текста 1 В и скажите, о чем, по вашему мнению, в нем может идти речь.

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* В скобках указано, сколько вопросов нужно составить.

Упр. 2. Назовите значения следующих интернациональных слов:

modern, accumulate, revolutionary, status, molecule, real, electronic, collection, principle, arrange, system

Упр. 3. Определите значения выделенных слов по контексту.

1. Dalton *developed* his theory between 1801 and 1808. 2. The atomic hypothesis *appeared* long ago. 3. A hypothesis is an *assumption* which explains or correlates the facts. 4. A theory *concerning* the structure of substances is the atomic theory. 5. The periodic law summarizes the *properties* of elements. 6. A verified idea is *no longer* a hypothesis. 7. Students want to have *deep* knowledge in chemistry. 8. Chemists study *the behaviour* of substances. 9. By Dalton's theory an atom was the smallest *particle.*

Слова к тексту:

direct evidence — прямое доказательство; **existence** — существование; **predict** — предсказывать; **indivisible** — неделимый; **size** — размер; **weight** — вес; **shape** — форма; **test-tube** — пробирка; **breakthrough** — проникновение, прорыв; **unrelated** — несвязанный; **mature** — зрелый

Text 1 B

Прочтите текст про себя (контрольное время чтения — 7 минут).

Dalton's Atomic Theory

One of the foundations of modern chemistry is Dalton's atomic theory developed between 1801 and 1808. When the atomic hypothesis appeared, there was no direct evidence of the existence of atoms. But as time passed, scientists found that the assumption of their existence and other assumptions concerning their properties and behaviour explain more and more of the accumulating experimantally determined facts of chemistry, and also predict other facts successfully. The hypothesis, therefore, gained the status of a theory.

There were revolutionary changes in chemistry in the last fifty years. Chemists found that atoms are not indivisible particles as Dalton thought, but consist of much smaller particles which form the structure of atoms. They established their sizes, weights and the arrangement of their parts with high accuracy, as well as the sizes and shapes of molecules and the internal structure of crystals. As a result, atoms and molecules are now as real as test-tubes. Chemistry has achieved not only a new look, but a major breakthrough to a deeper level of understanding. It is now possible to explain most of the properties of elements and their compounds in terms of their electronic, atomic and molecular structures. It is also possible to predict new properties successfully. Chemistry is no longer a collection of more or less unrelated facts, but a mature science founded on scientific principles which arrange facts in an orderly system.

Упр. 4. Скажите, совпали ли ваши предположения с содержанием текста: а) полностью; б) частично; в) совсем не совпали.

Упр. 5. Как иначе можно было бы озаглавить этот текст? На сколько тематических частей его можно разделить? Укажите начало и конец каждой части.

Упр. 6. Скажите, что говорится в тексте:

1) о том, как гипотеза об атомном строении вещества стала теорией; 2) об изменении химии как науки; 3) о том, что нужно делать, основываясь на современном уровне знания химии; 4) о том, как характеризуется современная химия.

Упр. 7. Найдите в тексте предложения, в которых говорится о том, как изменилась химия со времен Дальтона, и переведите их на русский язык.

Section III

Ex. 1. Ask your fellow students to do or not to do the following:

1) go to the blackboard; 2) open the door; 3) write the words on the blackboard; 4) clean the blackboard; 5) read the text aloud; 6) translate the sentence; 7) ask you about something

Ex. 2. a) Check up if you remember the following expressions:

Will you do it? Would you tell me? Don't you mind? Shall I read?

b) Translate the sentences into English using the above expressions.

1. Вы не возражаете, если я задам вам вопрос? 2. Пожалуйста, скажите мне, что такое закон. 3. Мне отвечать? 4. Не скажете ли вы, когда Дальтон разработал свою атомную теорию? 5. Вы ничего не имеете против, если я буду читать вслух? 6. Текст читать про себя? 7. Пожалуйста, объясните, как изменилась химия. 8. Мне сделать это сейчас, или это домашнее задание? 9. Не читайте этот текст без словаря: он очень трудный.

Ex. 3. Make up sentences with the following words and expressions:

1) fact, idea, explain, hypothesis, correlate; 2) law, represent, statement, about, facts, observe; 3) chemist, atomic, long ago, know, theory; 4) in the latest years, change, chemistry, revolutionary; 5) science, principle, scientific, chemistry

Ex. 4. Give detailed answers to the following questions:

1. What is the difference between a theory, a law and a hypothesis? 2. What are the two meanings of the word "theory"? 3. What laws in chemistry do you know? 4. How did Dalton's atomic hypothesis gain the status of a theory?

Ex. 5. Discuss the following topics:

1. Dalton's Atomic Theory.

2. The Changes in the Atomic Theory since Dalton's Time.
3. Chemistry as a Science.
4. What Scientists Know about the Structure of Substances.

DO YOU KNOW THAT...

M. V. Lomonosov (1711–1765) contributed greatly to the theoretical development of physics, astronomy, geography, mineralogy and other sciences. He worked out his own corpuscular theory and its chemical application. His corpuscular theory was the basis for the future development of the atomic theory. He is the founder of Russian physico-chemical science.

Lesson 2

ГРАММАТИКА: Простое сказуемое в действительном залоге (Continuous, Perfect).

Section I

Ex. 1. Pronounce the following words.

a)

e	[i:]	he, we, be, genius
e	[e]	let, help, next, effort, desk, get, left, lesson, member
er, er + согласная	[ɜ:]	her, serve, inert, certain, perfect, observe, service, determine
er + гласная	[ɪə]	here, period, mere
ear	[ɪə] [ɜ:]	hear, near learn, early, earth, research
ea ee	[i:]	teach, dream, clean, each, east, speak, leave, mean, read, sea, feature see, need, meet, green, agree, three, street, degree

b) chemical ['kemɪkəl], great [greɪt], nature ['neɪtʃə], allow [ə'laʊ], idea [aɪ'dɪə], experiment [ɪks'perɪmənt], bear [beə], colleague ['kɒli:g], uranium [ju'reɪnjəm], nuclear ['nju:klɪə]

Ex. 2. Read the following words and say what Russian words help to understand their meanings:

periodic, system, element, history, genius, characteristic, idea, calculation, modern, colleague, pedagogical, meteorology

Ex. 3. Pay attention to the following way of word-building:

основа глагола + *-tion* [ʃn] → существительное consideration, contribution, direction, prediction, calculation, foundation, intensification
основа глагола + *-er* (*-or*) [ə] → существительное teacher, researcher, founder, discoverer, writer, worker, explorer, observer, learner, receiver, speaker, visitor
основа слова + *-ic* [ik] → прилагательное periodic, characteristic, specific, energetic, economic, scientific, historic

Ex. 4. Give the initial forms of the following words:

served, greatest, making, shows, placed, properties, researches, ideas, hypotheses, theories, laid, closed, villages, areas, said, tried

Ex. 5. Define what parts of speech the italicized words belong to:

1. The periodic system of the *elements* was the greatest contribution to chemistry. 2. It was really the work of a *genius*. 3. It *adds* much to the present knowledge. 4. The element No. 101 *bears* the name of Mendeleyev. 5. The periodic system is the *basis* of modern teaching on substances.

Text 2 A

The World's Greatest Chemist

The periodic system of the chemical elements by Mendeleyev has long since served as the greatest history-making contribution to the study of nature. As any work of genius it shows two characteristic features: it adds more to the present knowledge, and it fruitfully develops along different directions in future.

It allowed to predict in advance the existence and properties of yet undiscovered elements. Many outstanding researchers owe to it, to a considerable degree, the ideas of their experiments, calculations, hypotheses and theories. Take, for example, the German Otto Hahn, who discovered the fission of the uranium nucleus. Or the American Glenn Seaborg who led a group of researchers that obtained, in laboratory conditions, a number of elements, including mendelevium, named in honour of Mendeleyev. That element bears the name of the great Russian scientist not only because Mendeleyev laid the foundation of the modern science of atom, but also because he drew his colleagues' special attention to uranium (No. 92), which at the time had closed his periodic table. A long train of transuraniums followed the once "final" uranium.

"The Mendeleyev system has served for almost 100 years as a key to discovering new elements," Seaborg wrote in 1955. It has retained its key capacity until now.

To commemorate Mendeleyev himself, the Soviet researchers named many newly discovered things on the earth or in the outer space after him: a crater on the "back" side of the Moon, an underwater ridge in the Arctic Ocean and the mineral mendeleyevite. Villages, streets and establishments such as the Moscow Institute of Chemical Technology, the Tobolsk Pedagogical Institute, the All-Russian Institute of Meteorology, the Museum of the St. Petersburg University building (where the scientist lived), the All-Russian Chemical Society, etc. have got Mendeleyev's name.

Mendeleyev, the explorer of nature, has found real immortality in his lasting heritage. The periodic system hasn't crumbled with time; on the contrary, its structure has expanded. At present it is the basis of modern teaching on substances, the structure of matter, atoms and nuclear energy.

"The greatest chemist of the world" — this is Mendeleyev's fame among modern chemists. Yes, he, the founder of modern chemistry and, to a large degree, of modern physics, considered physical chemistry his main subject, while he successfully dealt with problems in different areas, from mathematics and astronomy to meteorology, from philosophy to economics, from technology to art. "He has penetrated everywhere," the great Russian poet Alexander Blok once said.

Mendeleyev's notes on "three services to the Motherland" are quite interesting. He places work as an explorer of nature at the first place. He devoted himself to it. He tried to make his experimental and theoretical results serve society. He also devoted much of his effort to teaching, to the spread of knowledge. Finally, the third important task in Mendeleyev's life was to do his best for the economic and industrial progress of Russia.

Mendeleyev's dreams have come true. As long as seventy years ago the British magazine *Nature* (of February 24, 1934) wrote that in Russia scientists like Mendeleyev are valued and their works help to intensify the development of science, technology and industry.

Words and Word-Combinations to Be Memorized

almost, attention, basis, bear, calculation, characteristic, chemical, chemist, chemistry, contribution, develop, devote, direction, draw attention, element, existence, feature, found, knowledge, lay the foundation, modern, nature, outstanding, period, periodic, predict, present, at present, property, researcher, revolution, scientist, special, structure, subject, substance, system

Ex. 6. Give the Russian equivalents for the following:

the greatest chemist, the periodic system of the elements, any work, characteristic features, to predict in advance, undiscovered elements, an outstanding researcher, lay the foundation of smth., modern science, special attention, nuclear energy, deal with smth., devote oneself to, do one's best, chemical society

Ex. 7. Give the English equivalents for the following:

изучение природы, свойства элементов, носить имя кого-л., великий русский химик, современная химия, обратить внимание на что-л., назвать чьим-л. именем, всероссийский институт, наоборот, в настоящее время, физическая химия, основной предмет, мечты осуществились

Ex. 8. Fill in the blanks with prepositions where necessary.

of, on, in, to, after

1. The periodic system ... the elements allowed to predict ... the existence and properties ... some elements. 2. D. I. Mendeleyev laid the foundation ... the modern science ... atom. 3. D. I. Mendeleyev drew attention ... chemists ... uranium. 4. The Soviet researchers named many newly-discovered things ... the earth and ... the outer space ... Mendeleyev. 5. ... present the periodic law is the basis ... modern teaching ... substances. 6. D. I. Mendeleyev considered physical chemistry ... his main subject. 7. He devoted much ... his efforts ... teaching.

Ex. 9. Translate the sentences into Russian. Pay attention to the construction *there be.*

1. There are 9 elements in Group I. 2. There is only 1 electron in the hydrogen atom. 3. There are many things on the earth which are named after Mendeleyev. 4. There are many institutes in Russia which have got Mendeleyev's name. 5. There are some elements which don't exist in nature, scientists obtained them in laboratory. 6. There are some elements in Group I that are very active. 7. There are some elements which are not active. In what group are they? 8. There are many features in which elements differ radically. 9. Originally there were fewer elements in the periodic table.

Ex. 10. Translate the sentences into Russian.

1. Since its discovery the periodic system of the chemical elements has long served and is still serving as the greatest contribution to the study of nature. 2. This century has seen great changes in science and the life of people. 3. The ideas of many outstanding researchers originate from the periodic law. 4. The All-Russian Chemical Society bears the name of Mendeleyev. 5. The structure of the periodic system has expanded to a considerable degree. 6. A person of wide interests, Mendeleyev successfully dealt with problems in mathematics, astronomy, meteorology, philosophy, economics and art. 7. He placed work as an explorer of nature at the first place. 8. Mendeleyev tried to do his best for the economic and industrial progress of Russia. 9. Works of outstanding chemists help to intensify the development of science, technology and industry. 10. A Russian name appeared in 1964 on the honorary board of science at Bridgeport University, USA, — Mendeleyev's name appeared in the list of the greatest geniuses — Euclid, Archimedes, Copernicus, Galileo, Newton and Lavoisier. 11. Men-

deleyev published his periodic system in 1869. 12. Mendeleyev's law helped the American Glenn Seaborg who led a group of researchers to obtain a number of elements, including mendelevium, in laboratory conditions. 13. The laboratory led by Academician Georg Flyorov has been the cradle of many transuraniums. 14. Mendeleyev had been active in founding the Russian Chemical Society, which held its first meeting on November 6, 1868. 15. The predictions did not seem surprising; the successive discoveries of gallium (1874), scandium (1879), and germanium (1885) followed. 16. It is a remarkable fact that Mendeleyev actually spent only a few years in developing the periodic table, and then went on to other work.

Ex. 11. Translate the sentences into English.

1. Периодическая система элементов Д. И. Менделеева стала известна в 1869 году. 2. Она позволила заранее предсказать существование и свойства нескольких элементов. 3. Менделевий, один из трансурановых элементов, носит имя ученого, который привлек внимание коллег к урану. 4. Д. И. Менделеев — основатель современной химии и, в значительной степени, современной физики. 5. Он посвятил себя изучению природы. 6. Всю свою жизнь Д. И. Менделеев делал все возможное для прогресса России в области науки и экономики. 7. Его закон заложил основу для современной науки об атоме. 8. В настоящее время периодическая таблица сильно отличается от периодической таблицы 1869 года. 9. Каждый период таблицы Менделеева содержит определенное число элементов. 10. Например, в первом периоде — только два элемента. 11. До Менделеева были попытки расставить элементы в некотором порядке.

Ex. 12. Make up questions to the italicized parts of the sentences.

1. *Mendeleyev* is one of the greatest *chemists* (2). 2. He published *his* periodic *system in 1869* (3). 3. Mendeleyev *predicted* some properties of *undiscovered* elements (2).

Ex. 13. Answer the following questions:

1. Why is the periodic system by Mendeleyev valued so much? 2. Why does the element No. 101 bear Mendeleyev's name? 3. Has the periodic table changed with time? In what way has it changed? 4. What information is it possible to get from the periodic table of elements? 5. Was D. I. Mendeleyev a man of wide interests? Prove it. 6. What does the periodic law state?

Section II

Упр. 1. Прочтите заглавие текста 2 В и скажите, о чем, по вашему мнению, в нем может идти речь?

Упр. 2. Назовите значения следующих интернациональных слов:

examination, the Julian calendar, rudimentary, arrangement, vertical, horizontal, transpose, operate, bureau, visit

Упр. 3. Определите значения выделенных слов по контексту.

1. Mendeleyev *set down* his first ideas at breakfast. 2. He received a note about a visit to a cheese factory, but he *cancelled* the visit and worked on. 3. His mother operated a glass factory *to keep the wolf from the door*. 4. His mother *headed for* Moscow. 5. She wanted to place her son in the University of Moscow, but he *was refused*. 6. The government *retired* Mendeleyev from the University of St. Petersburg. 7. He became head of the Bureau of Weights and Measures in 1893 and *held that post* until his death.

Слова к тексту:

devise — придумывать; **brainwave** — осенившая кого-л. идея; **card** — карточка; **juggle** — манипулировать; **satisfy** — удовлетворять; **nap** — дремота, короткий сон; **go blind** — ослепнуть; **lease** — арендовать; **clash** — столкновение

Text 2 B

Прочтите текст про себя (контрольное время чтения — 7 минут).

The Mendeleyev Story

In a long examination of the periodic table of the elements, the *New Scientist* for March 7 tells briefly how Dmitry Ivanovich Mendeleyev (1834–1907) devised it. The Russian scientist had his brainwave, says author John Emsley, on March 1, 1869, but, because the Russians were still using the Julian calendar, it was February 17 in St. Petersburg, where Mendeleyev lived then.

Mendeleyev set down his first ideas at breakfast, on a note he had received about a visit to a cheese factory that day. He cancelled the visit and worked on. He drew up several rudimentary tables, Emsley says, and then made 63 cards, one for each of the known elements. On each card he put the properties of the element that he thought most important. He juggled the cards until he had an arrangement that satisfied him, wrote it down, and went to bed. He awoke from his nap with the idea that he should arrange the elements in vertical rather than horizontal groups and transposed them accordingly.

Mendeleyev was born in Siberia and was the last of 17 children. In the year of his birth his father went blind, and his mother leased and operated a glass factory to keep the wolf from the door. His father died in 1847, and the glass factory burned down in 1848. With this his mother headed for Moscow with Dmitry and his sister. Her idea was to place the son in the University of Moscow, but he was refused because he had been born in

Siberia. The same thing happened in St. Petersburg, but Dmitry's mother, ten weeks before death got him into the Pedagogic Institute there.

The government retired Mendeleyev from the University of St. Petersburg in 1890 for his political activities. He was made head of the Bureau of Weights and Measures in 1893 and held that post until his death.

Упр. 4. Скажите, что вы узнали из текста 2В; разделите его на тематические части и озаглавьте их.

Упр. 5. Скажите, что говорится в тексте:

1) о семье Д. И. Менделеева; 2) о том, как и куда он поступал учиться; 3) о том, как Д. И. Менделеев пришел к мысли о расположении элементов в таблице; 4) о том, чем занимался Д. И. Менделеев в последние годы своей жизни.

Ex. 6. Найдите в тексте и переведите на русский язык предложения, в которых говорится о том, как Д. И. Менделеев воплотил свою идею об упорядоченном расположении элементов.

Section III

Ex. 1. Think of the situations when the following expressions may be used:

to my mind; I don't think so; I agree with you; it's (quite) right; it's not right; sorry, you are wrong

Ex. 2. Express your agreement or disagreement with the following statements. Use expressions from exercise 1.

1. Mendeleyev was the only scientist who tried to arrange the elements. 2. A lot of new elements were predicted with the help of the periodic table. 3. To commemorate Mendeleyev, the Soviet researchers named many newly discovered things after him. 4. The periodic system didn't change with time. 5. Mendeleyev was interested only in chemistry. 6. Mendeleyev's family was small. 7. Mendeleyev got his education in St. Petersburg.

Ex. 3. Make up sentences or short stories with the following words and expressions:

1) be born, children, year, father, mother; 2) head, hold the post, bureau; 3) periodic system, serve, contribution, study; 4) the element, bear the name; 5) devote, teaching, development, economy, progress

Ex. 4. Give detailed answers to the following questions:

1. How did D. I. Mendeleyev devise his periodic table? 2. What is the importance of the periodic system of the elements? 3. Why do people call Mendeleyev "the greatest chemist of the world"? 4. What dreams of Mendeleyev have come true nowadays?

Ex. 5. Discuss the following topics:

1. The Discovery of the Periodic System of the Elements.
2. Mendeleyev's Life.
3. Mendeleyev's Interests.
4. The Periodic System of Elements at Present.

DO YOU KNOW THAT...

Mendeleyev planned to present his paper on the periodic table at the meeting of the Russian Chemical Society on March 6, 1869, but on that day he was ill. His friend N. S. Menshutkin (1842–1907), a noted Russian analytical chemist who was a colleague at the University of St. Petersburg read the paper for him. The communication did not evoke any unusual interest at this meeting.

Lesson 3

ГРАММАТИКА: Простое сказуемое в страдательном залоге.

Section I

Ex. 1. Pronounce the following words:

a)

i, y	[aɪ]	like, nine, side, sky, time, try, by, size, life, final, revise, strike, die, five, type
	[ɪ]	in, this, with, six, still, little, nickel, mixture, system, crystal, krypton, consist
i + r (+ согласная)	[ɜ:]	first, sir, bird, circle, dirty, girl, third, thirty
i + r + гласная	[aɪə]	fire, wire, entire
i + nd	[aɪ]	kind, mind, find, behind

b) thorough ['θʌrə], valence ['veɪləns], column ['kɒləm], immediately [ɪ'mi:djətlɪ], accept [ək'sept], weight [weɪt], whereas [weər'æz], isotope ['aɪsətəʊp], neutron ['nju:trɒn]

c) argon ['ɑgɒn], cobalt ['kəʊbɔ:lt], gallium ['gælɪəm], germanium [dʒɔ'meɪnɪəm], helium ['hi:ljəm], iodine ['aɪədi:n], krypton ['krɪptɒn], neon ['ni:ɒn], nickel ['nɪkl], potassium [pɔ'tæsjəm], protactinium [ˌprəʊtæk'tɪnɪəm], radium ['reɪdjəm], radon ['reɪdɒn], scandium ['skændɪəm], tellurium [te'ljuərɪəm], thorium ['θɔ:rɪəm], xenon ['zenɒn]

What are these elements?

Ex. 2. Read the following words and say what Russian words help to understand their meaning:

final, physical, special, valence, column, general, revise, position, indicate, isotope, mixture, mass, proton, neutron, vacant, radioactive, contain, group

Ex. 3. Pay attention to the following way of word-building:

основа слова + *-ance (-ence)* [əns] → существительное *-ance*: substance, significance, importance *-ence*: valence, existence, difference, occurrence, dependence
основа слова + *-ment* [mənt] → существительное establishment, experiment, development, statement, argument, measurement
основа слова + *-ward(s)* [wəd(z)] → наречие afterward(s), forward, eastward(s), homeward(s), downward(s)

Ex. 4. Give the initial forms of the following words and find them in the dictionary:

proposed, resembling, placed, discoveries, successes, pairs, occurring, higher, caused, indicated, changing

Ex. 5. Define what parts of speech the italicized words belong to. Translate the sentences into Russian.

1. Every *chemical* has its own *chemical* and physical properties. 2. In the evening he usually works in his *study*. 3. Chemists *study* properties of elements and their compounds. 4. There is a round *table* in the middle of the room. 5. Mendeleyev proposed his periodic *table* in 1869. 6. There are many *places* of interest in St. Petersburg. 7. Mendeleyev *places* the elements in the order of increasing atomic weight.

Text 3 A

The History of the Periodic Table

The final and most important step in the development of the periodic table was taken in 1869, when the Russian chemist Dmitry Ivanovich Mendeleyev (1834–1907) made a thorough study of the relation between the atomic weights of the elements and their physical and chemical properties, with special attention to valence. Mendeleyev proposed a periodic table containing seventeen columns, resembling in a general way the present periodic table without the noble gases. In 1871 Mendeleyev revised this table and placed a number of elements in different positions, corresponding to revised values of their atomic weights.

The "zero" group was added to the periodic table after the discovery of helium, neon, argon, krypton and xenon by Lord Rayleigh and Sir William Ramsay in 1894 and the following years.

The periodic law was accepted immediately after its proposal by Mendeleyev because of its success in making predictions with its use which were afterward verified by experiment. In 1871 Mendeleyev found that by changing seventeen elements from the positions indicated by the atomic weights which had been accepted for them into new positions, their properties could be better correlated with the properties of the other elements.

Most of the elements occur in the periodic table in the order of increasing atomic weights. There still remain, however, four pairs of elements in the inverted order of atomic weight; argon and potassium (the atomic numbers of argon and potassium are 18 and 19, respectively, whereas their atomic weights are 39.948 and 39.098), cobalt and nickel, telluruim and iodine, and protactinium and thorium. The nature of the isotopes of these elements is such that the atomic weight of the naturally occurring mixture of isotopes is greater for the element of the lower atomic number in each of these pairs than for the element of higher atomic number; thus, argon consists almost entirely (99.6%) of the isotope with mass number 40 (18 protons, 22 neutrons), whereas potassium consists largely (93.4%) of the isotope with mass number 39 (19 protons, 20 neutrons). This inversion of the order in the periodic system, as indicated by the chemical properties of the elements, from that of atomic weight caused much concern before the atomic numbers of the elements were discovered, but has now been recognized as having little significance.

A very striking application of the periodic law was made by Mendeleyev. He predicted the existence of six elements which had not yet been discovered, corresponding to vacant places in his table. Three of these elements were soon discovered (they were named scandium, gallium, and germanium by their discoverers), and it was found that their properties and the properties of their compounds are very close to those predicted by Mendeleyev.

After helium and argon had been discovered, the existence of neon, krypton, xenon, and radon was clearly indicated by the periodic law, and the search for those elements in air led to the discovery of the first three of them; radon was then discovered during the investigation of the properties of radium and other radioactive substances.

Words and Word-Combinations to Be Memorized

accept, add, air, application, because of, cause, close, column, compound, concern, contain, discovery, entirely, following, gas, however, immediately, important, increase, inverse, investigation, isotope, largely, lead, mixture, neutron, noble, occur, pair, physical, propose, proton, recognize, relation, resemble, respectively, revise, search, significance, soon, step, still, striking, success, thorough, vacant, valence, value, weight, whereas

Ex. 6. Give the Russian equivalents for the following:

take steps, make a thorough study, propose, column, in a general way, corresponding to, the following years, accept a law, immediately, because of, make predictions, most of, occur, in the order of, still, in the inverted order, respectively, whereas, almost entirely, largely, cause concern, recognize, little significance, application, soon, be close to smth., indicate clearly, during the investigation, radioactive substances

Ex. 7. Give the English equivalents for the following:

наиболее важный шаг, периодическая таблица, отношение, атомный вес, между, особое внимание, содержать, инертный газ, пересмотреть таблицу, ряд элементов, нулевая группа, добавить к чему-л., успех, большинство элементов, в обратном порядке, атомный номер, смесь изотопов, состоять из, протон, нейтрон, главным образом, большое значение, применение, свободные места в таблице, таким образом, вскоре, химическое соединение, в воздухе, привести к

Ex. 8. Fill in the blanks with prepositions where necessary.

by, of, to, in, after, without, between

1. D. I. Mendeleyev made ... a thorough study ... the relation ... the atomic weights ... the elements and their properties. 2. Mendeleyev's periodic table consisted ... seventeen columns. 3. ... a general way Mendeleyev's table resembled ... the present periodic table ... the noble gases. 4. Mendeleyev placed ... a number ... elements ... different positions. 5. The periodic law was accepted ... its proposal ... Mendeleyev. 6. Most ... the elements occur ... the periodic table ... the order ... increasing atomic weights. 7. Mendeleyev predicted the existence ... six elements corresponding ... vacant places ... his table. 8. The properties ... the newly discovered elements were very close ... the properties predicted ... him.

Ex. 9. Translate the sentences into Russian. Pay attention to the meaning of the word *that* (*those*).

1. Put your bag on *that* table. 2. Mendeleyev found *that* the atomic weights were correlated with the properties of corresponding elements. 3. The atomic weight of potassium is 39.098 and *that* of argon is 39.948. 4. The inversion of the order in the periodic system from *that* of atomic weight caused much concern. 5. The properties of the elements and *those* of their compounds are close to *those* predicted by Mendeleyev. 6. *That* difficulty exists no more. 7. The properties of *those* compounds are different. 8. Elements from Group I differ from *those* of Group II.

Ex. 10. a) Write the three forms of the following verbs:

find, have, do, be, mean, know, study, show, bear, lay, draw, found, try, come, take, make, lead, predict, resemble

b) Translate the sentences into Russian.

1. Special attention was drawn to valence. 2. The most important step was taken when Mendeleyev studied the relation between the atomic weights and the properties of the elements. 3. This final step was taken by the great Russian chemist in 1869. 4. A periodic table containing seventeen columns was proposed by him. 5. In 1871 the table was revised corresponding to revised values of the atomic weights of some elements.

6. The periodic law was accepted and widely used by chemists. 7. It was found that the atomic weights which had been accepted for some elements were not accurate. 8. After the paper on the periodic table was presented, it was soon published in Russian and in German. 9. Properties of chemical elements and compounds are thoroughly studied in laboratories. 10. Some elements were given new places in the table after the revision of their atomic weights. 11. The inversion of the order in the periodic system has now been recognized as having little significance. 12. The periodic law is widely applied by chemists. 13. Radon was discovered during the investigation of the properties of radium and radioactive substances.

Ex. 11. Translate the sentences into English.

1. Когда Менделеев разрабатывал периодическую систему, многие элементы еще не были открыты. 2. Русское химическое общество было основано в 1868 году. 3. Нулевая группа была добавлена к периодической таблице после открытия инертных газов. 4. Предсказания Менделеева оправдались последующим открытием новых элементов. 5. Гелий, неон, аргон, криптон и ксенон были открыты в 1894 году и в последующие годы. 6. Всю свою жизнь Менделеев посвятил развитию науки. 7. Химические свойства указывали на нарушение порядка в нескольких местах в таблице. 8. Менделеев предсказал существование шести элементов.

Ex. 12. Make up questions to the italicized parts of the sentences.

1. *Mendeleyev* proposed a periodic *table* containing seventeen columns (2). 2. The *periodic* table was accepted *immediately after its proposal* (2). 3. Most of the elements *occur in the periodic table* in the order of increasing atomic weight (2).

Ex. 13. Answer the following questions:

1. When did Mendeleyev present his periodic system? 2. Were there noble gases in his periodic table? 3. Why did Mendeleyev revise his table? 4. What elements are there in Group "0"? 5. How are elements arranged in the system? 6. Why are there elements in the inverted order of atomic weights? 7. What discoveries verified Mendeleyev's predictions?

Section II

Упр. 1. Прочтите заглавие текста 3 В, бегло просмотрите его и кратко расскажите, о чем он.

Упр. 2. Назовите значения следующих интернациональных слов:

modern, form, systematic, inert, cube, formula, composition, horizontal, period, vertical, group

Упр. 3. Определите значения выделенных слов по контексту.

1. The atomic numbers of helium and neon are 2 and 10, those of lithium and sodium are *one greater* (3 and 11). 2. The elements 3, 11, 19, 37, 55 and 87 are very *reactive* chemically. 3. The sky in summer is often blue, but air is *colourless*. 4. The properties of the elements Li, Na, K, Rb, Cs and Fr resemble each other, and those of their compounds are *similar*. 5. The horizontal *rows* of the periodic table are called periods. 6. The seventh period on which the elements 106 and 107 have a hypothetical existence is called *incomplete*. 7. Chemists speak about the *recurrence* of properties, because similar properties do occur again and again in every next period.

Слова к тексту:

cleavage — расщепление; **congener** — принадлежащий к одному роду; **arbitrary** — произвольный, случайный; **vary** — изменяться; **dependence** — зависимость; **connection** — связь

Text 3 B

Прочтите текст про себя (контрольное время чтения — 6 минут).

The Periodic Table of the Elements

One of the most valuable parts of chemical theory is the periodic law. In its modern form this law states simply that the properties of the chemical elements are not arbitrary, but depend upon the electronic structure of the atom and vary with the atomic number in a systematic way. The important point is that this dependence involves periodicity that shows itself in the periodic recurrence of characteristic properties.

For example, the elements with atomic numbers 2, 10, 18, 36, 54, and 86 are all chemically inert gases. Similarly, the elements with atomic numbers one greater — namely 3, 11, 19, 37, 55, and 87 are all light metals that are very reactive chemically. These six metals — lithium (3), sodium (11), potassium (19), rubidium (37), cesium (55) and francium (87) — all react with chlorine and form colourless salts that crystallize in cubes and show a cubic cleavage. The chemical formulas of these salts are similar: LiCl, NaCl, KCl, RbCl, CsCl, and FrCl. The composition and properties of other compounds of these six metals are correspondingly similar, and different from those of other elements.

The horizontal rows of the periodic table are called periods: they consist of a very short period (containing hydrogen and helium, atomic numbers 1 and 2), two short periods of 8 elements each, two long periods of 18 elements each, a very long period of 32 elements, and an incomplete period.

The vertical columns of the periodic table, with connections between the short and long periods as shown, are the groups of chemical elements. Elements in the same group are sometimes called congeners; these elements have closely related physical and chemical properties.

Упр. 4. Скажите, узнали ли вы что-нибудь новое из этого текста. Если да, то что именно?

Упр. 5. Разделите текст на тематические части и озаглавьте их.

Упр. 6. Скажите, что говорится в тексте:

1) о строении периодической таблицы; 2) о периодах; 3) о группах элементов; 4) о том, как выявляется периодичность химических и физических свойств элементов.

Упр. 7. Найдите в тексте современную формулировку периодического закона и переведите ее на русский язык.

Section III

Ex. 1. Think of the situations when the following expressions may be used:

it's a pity; what a pity; not at all; never mind; I'm not surprised; I don't think so; I have no idea; excuse me (for)

Ex. 2. Translate the sentences into English using expressions from exercise 1.

1. Простите, что я пришел так поздно. — Ничего, я еще долго буду здесь. 2. Петров получил двойку за контрольную работу. — Не могу этому поверить. Он всегда хорошо занимался. 3. Как жаль, что я не приду завтра на семинар, он будет интересным. — Я так не думаю. 4. Спасибо, что сказали мне об этом. — Не за что. 5. Я читал этот текст с большим интересом. — Не удивительно, он ведь о Менделееве. 6. Завтра в 3 часа будет сообщение о новых результатах исследований. — Жаль, я не приду, у меня в 3 часа лекция. 7. Ты не знаешь, когда он представит свою работу? — Понятия не имею.

Ex. 3. Make up sentences or short stories with the following words:

1) relation, study, weight, property, lead to, periodic, discovery, table; 2) occur, element, order, table, periodic, systematic; 3) consist, isotope, argon, entirely, almost, mass, 40, number; 4) predict, yet, Mendeleyev, discover, existence, which, element, not, six; 5) periodic, horizontal, table, row, consist, call, period, element; 6) vertical, periodic, column, table, group, call

Ex. 4. Give detailed answers to the following questions:

1. What does the periodic law state? 2. How does the periodicity of elements show itself? 3. What do you know about periods of elements? 4. What do you know about groups of elements? 5. Why was the periodic law accepted immediately after its proposal?

Ex. 5. Discuss the following topics:

1. The History of the Periodic System.

2. The Description of the Periodic Table.
3. Predictions Come True.
4. Characteristic Features of One of the Groups of Elements.

DO YOU KNOW THAT...

At present 109 elements are known to the world science, some of them have only hypothetical existence. Attempts are being made to synthesize them in laboratory. Two elements bear the names of great Russian scientists Mendeleyev and Kurchatov. They are No. 101 (mendelevium) and No. 104 (kurchatovium). The development of the science of periodicity was greatly influenced by the synthesis of transuraniums. Ruthenium (No. 44) was named in honour of Russia.

Lesson 4

ГРАММАТИКА: Особые случаи выражения сказуемого глаголом в страдательном залоге.

Section I

Ex. 1. Pronounce the following words:

a)

o	[əʊ]	no, so, role, close, those, note, ago, devote, over, hope
but:	[ʌ]	one, none
	[ɔʊ]	old, cold, only
o	[ɒ]	on, long, not, box, clock, dog, hot, shop, soft, stop, strong
o	[ʌ]	love, above, cover, discover, come, some, among, other, mother, brother
or (+ согласная)	[ɔ:]	for, form, order, north, port, short
but:	[ɜ:]	work, word, world
or + гласная	[ɔ:]	more, before, explore, store
oor	[ɔ:]	door, floor
but:	[ʊə]	poor
oo	[ʊ]	book, look, foot, good
	[u:]	room, food, soon, moon, noon

b) oxygen ['ɒksɪdʒ(ə)n], amateur ['æmətɜ:], adherent [əd'hɪərənt], various ['veərɪəs], particularly [pə'tɪkjʊlə(l)ɪ], evidence ['evɪdəns], phlogiston [flɒ'dʒɪstən], combustion [kəm'bʌstʃən], concept ['kɒnsəpt], average ['ævərɪdʒ], atmosphere ['ætməsfɪə]

Ex. 2. Read the following words and say what Russian words help to understand their meaning:

religious, pharmacist, component, atmosphere, publication, role, phlogiston, basis, concept, combination, Swedish, French, metal, product

Ex. 3. Pay attention to the following way of word-building:

основа слова + *-age* [ɪdʒ] → существительное average, heritage, language
основа слова + *-ry* [rɪ] → существительное theory, century, country, factory, history, industry, discovery
основа слова + *-tude* [tju(:)d] → существительное multitude, magnitude

Ex. 4. Arrange the words in the alphabetic order and find their meaning in the dictionary.

credit, share, clergyman, amateur, persecution, derive, delay, ardent, adherent, yield, volume, extent, independently, mercuric

Ex. 5. Define what parts of speech the italicized words belong to. Translate the sentences into Russian. Use the dictionary if necessary.

1. Priestley's *work* was published in 1774. 2. The students of our group *work* hard at their English. 3. Sheele's *experiments* had probably been performed even earlier than Priestley's. 4. He *experiments* on this substance to make its composition clear. 5. Oxygen *plays* an important role in combustion. 6. The *plays* by A. P. Chekhov are known all over the world. 7. *Air* the room, please. 8. Oxygen makes up 21 per cent of *air*. 9. The *yield* of this reaction is usually good. 10. As a result of combustion many substances *yield* products which react with water and give acidic solutions. 11. She looks *fine* today. 12. Priestley's *fine* work gave good results.

Text 4 A

Oxygen: History and Occurrence

Credit for the discovery of oxygen is shared by two men, Joseph Priestley, an English clergyman and amateur scientist, who later moved to the United States to escape religious persecution, and Carl Wilhelm Scheele, a Swedish pharmacist. Working independently, these two men both obtained the gas which we know as oxygen by heating various compounds of the element, particularly mercuric oxide. They also found evidence that this gas is a component of the atmosphere. Priestley's work was published in 1774, but although Scheele's experiments had probably been performed even earlier, their publication was delayed and no account of them appeared

until 1777. Though Priestley recognized that the gas which he had discovered plays an important role in combustion, he remained, along with Scheele, an ardent adherent of the phlogiston theory of combustion; in fact, he called the gas "dephlogisticated air".

On the basis of the experimental results of Priestley, Scheele, and others, as well as some very fine experimental work of his own, in 1777 the brilliant French chemist Lavoisier established the modern concept that the combustion of a substance consists in its combination with the new gas which Priestley and Scheele had described, and which Lavoisier found an important constituent of the atmosphere. Since the combustion of many substances (now known as non-metals) such as phosphorus and sulphur yields products which react with water and give acidic solutions, Lavoisier named this gas oxygen, derived from Greek words meaning "acid former".

Oxygen occurs in the free state as the second most abundant component of the atmosphere; about one-fifth of the air by volume is oxygen. In the combined state it makes up 88.81% by weight of pure water, and, on the average, 85.79% of sea water. It occurs in the earth's crust, in the form of a multitude of compounds, to the estimated extent of 46.43%.

Words and Word-Combinations to Be Memorized

abundant, account, acid, air, although, appear, atmosphere, on the average, combination, combustion, component, concept, consist in, constituent, earth, escape, establish, estimate, even, evidence, fine, free, heat, make up, metal, obtain, occurrence, oxide, oxygen, own, particularly, perform, play a role, probably, product, publication, publish, pure, react, since, solution, though, until, very, as well as, yield

Ex. 6. Give the Russian equivalents for the following:

move to, escape smth., obtain, by heating, particularly, find evidence, be a component of smth., although, perform an experiment, even earlier, appear, until, though, along with, in fact, on the basis of, as well as, very fine experimental work, modern concept, work of one's own, consist in smth., since, such as, yield products, an acidic solution, the second most abundant component, about one-fifth by volume, in the combined state, on the average

Ex. 7. Give the English equivalents for the following:

различные соединения, путем нагревания, особенно, найти доказательство, составная часть атмосферы, хотя, опубликовать работу, признавать, играть важную роль, наряду с, на основании, так же как, тонкая работа, современное понятие, заключаться в, так как, неметалл, давать продукты, реагировать с, в свободном состоянии, встречаться в атмосфере, около 90% по весу, чистая вода, в среднем, морская вода

Ex. 8. Fill in the blanks with prepositions and conjunctions where necessary.

of, by, in, about, as well as, and, on

1. Scheele ... Priestley obtained ... oxygen ... heating various compounds ... the element. 2. Priestley recognized that the gas obtained ... him plays an important role ... combustion. 3. Priestley ... Scheele remained adherent ... the phlogiston theory ... combustion. 4. ... the basis ... the experimental results ... the earlier workers Lavoisier established his own concept ... combustion. 5. The combustion ... a substance consists ... its combination with oxygen. 6. Oxygen occurs ... the free state ... the atmosphere. 7. ... one-fifth ... the air ... volume is oxygen.

Ex. 9. Practise the fractional numerals.

a) Простые дроби.

Model: $^1/_2$ — a (one) half
$^1/_3$ — a (one) third
$^2/_3$ — two thirds
$1^1/_2$ — one and a half
$2\ ^2/_3$ — two and two thirds

$^1/_4$, $^2/_5$, $1^1/_6$, $10^1/_2$, $7^6/_8$, $12^1/_3$, $15^3/_4$, $3^1/_5$, $6^1/_{12}$, $4^1/_{10}$

b) Десятичные дроби.

Model: 0.1 — nought point one
0.01 — nought point nought one (point nought one)
2.54 — two point five four

0.2, 0.15, 1.25, 0.001, 3.42, 52.03, 0.14, 0.7

c) Проценты.

Model: 3% — three per cent (*Latin* — pro centum)
$^2/_5$% — two fifths per cent
0.1% — nought point one per cent

1%, 7%, 25%, 0.2%, $^1/_5$%, 27.3%, 81.357%, 16.5%

Ex. 10. Translate into Russian.

a) will be discussed, was being studied, will have been taken, are named, had been discovered, will be obtained, have been written, were being translated, shall have done, are used, is being done, will be produced, was asked, are taught, will be given

b) 1. Oxygen was obtained by Scheele and Priestley independently. 2. Oxygen was obtained by heating mercuric oxide. 3. Evidence was found that this gas is a component of the atmosphere. 4. The theory of phlogiston is not much spoken about at present. 5. An important role of oxygen in combustion was discovered by Priestley. 6. The gas obtained was called by him "dephlogisticated air". 7. The modern concept of

combustion was established by Lavoisier. 8. Substances such as phosphorus and sulphur are known as non-metals. 9. The name "oxygen" was derived from Greek words meaning "acid former". 10. Oxygen is found in the free state in the atmosphere. 11. When a substance is attacked by oxygen, it forms an oxide or a number of oxides. 12. Not unfrequently the elements helium, neon, argon, krypton and xenon are referred to as noble gases. 13. Gold is unaffected by oxygen. 14. Many kinds of oxides are met with in the study of chemistry. 15. By Dalton's atomic theory atoms were looked at as indivisible constituents of substances. 16. Potassium is quickly acted on by the oxygen of the air. 17. Oxygen is constantly being put back to the atmosphere by trees and other plants. 18. This method has been followed since the time of Priestley. 19. The lecture was followed by the demonstration of experiments. 20. The first success was followed by many others. 21. The yield of the reaction is greatly affected by temperature. 22. Attention was drawn to the valence of substances. 23. Attempts were made to obtain pure oxygen. 24. Much attention has been given recently to the study of this group of oxides.

Ex. 11. Translate the sentences into English.

1. Современное понятие горения было установлено Лавуазье в 1777 году. 2. Этот газ был назван «образующим кислоты». 3. Кислород был найден в земной коре в виде соединений. 4. Кислород был получен нагреванием различных соединений этого элемента, в частности, оксида ртути. 5. Работа Пристли была опубликована в 1774 году. 6. Кислород был открыт и описан во второй половине XVIII века. 7. Такие вещества, как калий, известны как очень активные металлы. 8. На золото кислород не действует ни при какой температуре.

Ex. 12. Make up questions to the italicized parts of the sentences.

1. *Priestley* lived and worked *in England* and then *in the United States* (3). 2. *Oxygen* was obtained *by heating various* compounds of *this* element (3). 3. *The word "oxygen"* derived from Greek means *"acid former"* (2).

Ex. 13. Answer the following questions:

1. What famous scientists worked on the discovery of oxygen? 2. Who was the first to obtain this gas? 3. What was the method of obtaining oxygen? 4. What theory of combustion existed in Priestley's time? 5. What did the French chemist Lavoisier establish? 6. What does the modern concept of combustion state? 7. What does the word "oxygen" mean? 8. Where does oxygen occur and in what state?

Section II

Упр. 1. Прочтите заглавие текста 4 В. Бегло просмотрите его и кратко расскажите, о чем он.

Упр. 2. a) Назовите значения следующих интернациональных слов:

essential, respiration, process, diatomic, litre, atmosphere, crystalline, laboratory, accelerate, distillation, control, condition, cylinder, electrolysis, condense

b) Назовите следующие элементы:

potassium, chlorine, manganese, nitrogen, hydrogen

Упр. 3. Определите значения выделенных слов по контексту.

1. *Water* is a compound with the formula H_2O. 2. Oxygen supports *combustion*. 3. A gas which has no colour and odour is called *colourless* and *odourless*. 4. One litre of water at 0°C *dissolves* 48.9 ml of oxygen gas at 1-atm *pressure*. 5. *The boiling point* of water is 100°C. 6. Water *freezes* at 0°C. 7. Above 0°C water is *liquid* and below 0°C it is *solid*. 8. Heating potassium chlorate is followed by *the evolution* of oxygen. 9. When water is boiling, it is *evaporating*. 10. Oxygen is *stored* in steel cylinders. 11. When the reaction proceeds very quickly, we usually say that its *rate* is high. 12. In the laboratory oxygen is obtained by heating $KClO_3$, and *commercially* it is made by the distillation of liquid air. 13. Oxygen is *soluble* in water very little.

Слова к тексту:

fire — огонь; **odour** — запах; **pale** — бледный; **melt** — плавиться; **amount** — количество; **volatile** — летучий; **tend** — стремиться

Text 4 B

Прочтите текст про себя (контрольное время чтения — 5 минут).

Oxygen

Oxygen is one of the most abundant elements. It forms 21 per cent of the atmosphere, 89 per cent of the water, and about 50 per cent of the earth's crust. Without oxygen, life cannot exist, as well as fire. Oxygen is essential in supporting respiration and combustion, it is used in many modern industrial processes. The element consists of diatomic molecules.

It is a colourless, odourless gas, which is slightly soluble in water: 1 litre of water at 0° dissolves 48.9 ml of oxygen gas at 1-atm pressure. Its density at 0°C and 1 atm is 1.429 g $litre^{-1}$. Oxygen condenses to a pale blue liquid at its boiling point, –183.0°C, and on further cooling freezes at –218.4°C to a pale blue crystalline solid.

Oxygen is easily prepared in the laboratory by heating potassium chlorate,

$$KClO_3 : 2KClO_3 \rightarrow 2KCl + 3O_2\ (g).$$

The reaction proceeds at a temperature just above the melting point of potassium chlorate if a small amount of manganese dioxide, MnO_2, is mixed with it. Although the manganese dioxide accelerates the rate of evolution of oxygen from the potassium chlorate, it itself is not changed.

Oxygen is made commercially mainly by the distillation of liquid air. Nitrogen is more volatile than oxygen, and tends to evaporate first from liquid air. Nearly pure oxygen is obtained by properly controlling the conditions of the evaporation. Oxygen is stored and shipped in steel cylinders, at pressures of 100 atm or more. Oxygen is also made commercially, together with hydrogen, by the electrolysis of water.

Упр. 4. Скажите, чем отличается текст 4 В от текста 4 А.

Упр. 5. Разделите текст на тематические части и озаглавьте каждую часть.

Упр. 6. Скажите, что говорится в тексте:

1) о распространении кислорода; 2) о его физических свойствах; 3) о получении кислорода в лаборатории; 4) о промышленном получении кислорода; 5) о его хранении.

Упр. 7. Найдите в тексте и переведите на русский язык все предложения, в которых говорится о получении кислорода в промышленности.

Section III

Ex. 1. Think of situations when the following expressions may be used:

sorry, I'm sorry, excuse me, that's all right, never mind, not at all, thank you, thanks

Ex. 2. Translate the following sentences into English. Let your fellow students respond to them. Use expressions from exercise 1.

1. Извините, я опоздал. 2. Прости, что я не закончил перевод, меня зовут в лабораторию. 3. Спасибо, что ты помог мне. 4. Извини, я еще не знаю, что буду делать завтра. 5. Спасибо за книгу. Я прочел ее за 2 дня. Она очень интересная. 6. Жаль, но по химии я получил только «3». 7. Тебе нравится математика? 8. О чем говорил преподаватель на прошлом занятии?

Ex. 3. Make up sentences or short stories with the following words:

1) be, Priestley, scientist, amateur, English; 2) pharmacist, work, Swedish, Scheele, independently, obtain, gas, oxygen, know, we; 3) they, gas, role, combustion, find, play, evidence, important; 4) French, Lavoisier, modern, combustion, chemist, establish, theory; 5) free oxygen, second, state, occur, most, component, atmosphere, abundant; 6) generally, obtain, liquid, oxygen, commercially, air, distillation; 7) way, oxygen, be, another, obtain, water, electrolysis

Ex. 4. Give detailed answers to the following questions:

1. In what way did Priestley and Scheele obtain oxygen? 2. What is the modern concept of combustion? 3. What is the role of oxygen in combustion? 4. Who established this concept first? 5. Is oxygen an abundant element? Give some examples. 6. What are the physical properties of oxygen? 7. What ways of preparing oxygen in the laboratory do you know? 8. How is oxygen made commercially?

Ex. 5. Discuss the following topics:

1. Physical Properties of Oxygen.
2. Chemical Properties of Oxygen.
3. Preparation of Oxygen.
4. The History of the Discovery of Oxygen.

DO YOU KNOW THAT...

The phlogiston theory of combustion was still prevalent in Russia in the middle of the eighteenth century. It came into conflict with the corpuscular theory put forward by Lomonosov. His experiments on the calcination of metals helped Lomonosov to find evidence against it and led him to the discovery of the main law of chemistry — the law of conservation of mass and energy.

Lesson 5

ГРАММАТИКА: Согласование времен.

Section I

Ex. 1. Pronounce the following words:

a)

u	[ju:]	use, duc, cube, huge, human, future, refuse, deduce, duty, assume, music
but:	[u:]	blue, true
u	[ʌ]	up, but, cut, thus, such, publish, hundred, result, crust, just, number, much, combustion, substance
but:	[ʊ]	put, full
ur (+ согласная)	[ɜ:]	turn, burn, occur, purpose, surface, further
ur + гласная	[jʊə]	pure, during
eu	[ju:]	neutral neutron, pneumatic, pneumonia
ew		new, few

b) calcium [ˈkælsɪəm], carbide [ˈkɑ:baɪd], commercial [kəˈmɜ:ʃəl], liquefaction [ˌlɪkwɪˈfækʃən], acetylene [əˈsetɪli:n], broad [brɔ:d], field [fi:ld], garage [ˈgærɑ:ʒ], automobile [ˈɔ:təməˌbi:l], manufacture [ˌmænjuˈfæktʃə], refrigerator [rɪˈfrɪdʒəreɪtə], iron [ˈaɪən], disease [dɪˈzi:z], altitude [ˈæltɪtju:d], health [helθ], pneumonia [nju(:)ˈməunjə]

Ex. 2. Read the following words and say what Russian words help to understand their meaning.

interest, gas, active, actual, extremely, factor, speed, method, economically, calcium, carbide, scale, process, fractional distillation, technically, temperature, revolutionize, defect, operate, industrially, rectification, acetylene, proportion, basis, practically, division, production, garage, automobile, manufacture, refrigerator

Ex. 3. Pay attention to the following way of word-building:

основа слова + *-ture* [tʃə] → существительное nature, structure, mixture, feature, picture, temperature, manufacture but: *-sure* pressure [-ʃə], measure [-ʒə]
основа слова (иногда с чередованием гласных корня) + *-th* → существительное strength, length, depth, death, breath, health
основа слова + *-less* → прилагательное useless, senseless, colourless, odourless, tasteless, featureless

Ex. 4. Give the initial forms of the following words, arrange them in the alphabetic order and find their meaning in a dictionary.

mixed, welding, divided, fields, perhaps, equipment, applied, surfaces, altitudes, otherwise, feet, besides, required

Ex. 5. Using the context and a dictionary give the right meaning of the italicized words.

1. He usually finds his own *way* to do the work. 2. There is no other *way* out. 3. In this *way*, the oxy-acetylene process is applied almost in every field of industry. 4. How *long* is a foot? — It is 30.48 centimetres. 5. The phlogiston theory no *longer* exists. 6. The academic year is divided into two *terms*. 7. Technical *terms* are easy to learn if there are Russian analogues. 8. Elements are classified in *terms* of their properties. 9. My friend lives not *far* from the University. 10. By *far* the greatest volume of oxygen is used for industrial purposes.

Text 5 A

Modern Uses of Oxygen

Although oxygen has been used in industry for more than 100 years, there has been interest in this colourless, odourless, tasteless gas for several hundred years. Its presence as an active element in the air was suspected as long ago as 1500 A. D., but only in 1777 Antoine Lavoisier, a French chemist, named oxygen and described its properties.

The actual development of the industrial application of oxygen for the next hundred years was extremely slow. Then, at the turn of the twentieth century, two factors greatly speeded progress. One was a method for economically producing oxygen of high purity from the air, and the other was a method for producing calcium carbide on a commercial scale.

Probably 95 per cent of the huge volume of oxygen used today is obtained from the air by a process which was developed by Dr. Carl von Linde in Germany in 1895 and 1902. This method is based upon the liquefaction of air and its fractional distillation. Technically, the process is complicated, as it requires one of the lowest temperatures used industrially — more than 300°F below zero (–194.4°C). The liquid air is a very cold mixture of liquid oxygen and liquid nitrogen. Oxygen is then separated by rectification. Most oxygen produced for industrial purposes is purer than 99 per cent.

Calcium carbide treated with water produces acetylene, a gas which burns in air with a brilliant white light. When the two gases, oxygen and acetylene are mixed in proper proportions and burned, their combustion produces the hottest flame known — more than 5400°F (≈ 3000°C). This flame for the past 100 years has formed the basis for the oxy-acetylene process for welding and cutting metals.

Today there is practically no industry which does not use the process. Broadly speaking, applications are divided into two fields — repair and production. The repair field is perhaps the better known, for practically every garage uses the oxy-acetylene process for repairing automobile parts. In industry, there is not a factory which does not use the process in many different ways for repairing the equipment.

Another process where acetylene is used, is called "hard-facing"*. Extremely hard alloys are applied to the surfaces of metal parts, increasing the life of the parts many times.

Certain industries have developed mostly due to welding. This is true in the manufacture of airplanes, automobiles, refrigerators, railway roads.

But the greatest amount of oxygen is used in cutting iron and steel — one of the most spectacular applications of oxygen in industry. This simple process has literally revolutionized the metalworking industries. It was found that any cuts were made quite easily.

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* **hard-facing** — покрытие твердым слоем, упрочнение поверхности

One of the most recent applications of the oxy-acetylene process is for removing surface defects from steel. In this way, larger amounts of cleaner and better steel are made possible at lower cost.

Although by far the greatest volume of oxygen — amounting to several billion cubic feet a year — is used for industrial purposes, an ever increasing amount of oxygen is being used in medicine, the treatment of diseases, such as pneumonia or heart diseases. It has saved many lives. Besides, while breathing oxygen, aircraft pilots operate at altitudes otherwise impractical without it.

It may be said that oxygen is men's best friend — both in industry and for human health.

Words and Word-Combinations to Be Memorized

acetylene, actual, amount, apply, base, below, besides, burn, calcium, carbide, commercial, complicated, development, distillation, divide, equipment, ever, extremely, factor, foot (feet), fractional, human, interest, iron, liquid, manufacture, mix, nitrogen, operate, past, possible, practically, presence, process, production, proportion, recent, scale, separate, speed, steel, taste, tasteless, technically, temperature, than, true, at the turn of the century, while

Ex. 6. Give the Russian equivalents for the following:

long ago, more than, less than, industrial application, extremely slow, at the turn of the twentieth century, speed progress, high purity, on a commercial scale, huge volume, obtain by a process, develop a process, liquid air, separate, for industrial purposes, treat with smth., mix in proper proportions, form the basis for smth., automobile parts, the metalworking industries, remove a defect, treat a disease, breathe oxygen

Ex. 7. Give the English equivalents for the following:

активный элемент, только, в промышленных масштабах, вероятно, карбид кальция, получить из воздуха, разработать метод, фракционная перегонка, самая низкая температура, ниже нуля, выше нуля, жидкий воздух, для промышленных целей, гореть на воздухе, разделить на, металлические детали, наибольшее количество, простой процесс, таким образом, возможный, хотя, кроме того, лучший друг человека

Ex. 8. Fill in the blanks with prepositions where necessary.

of, at, in, for, from, upon, with

1. Oxygen has been used ... undustry ... more than 100 years. 2. The actual development ... the industrial application ... oxygen began ... the turn of the twentieth century. 3. Today probably 95 per cent ... the huge volume ... oxygen is obtained ... the air. 4. This method is based ... the liquefaction ... air and its fractional distillation. 5. When calcium carbide is treated ... water, it produces acetylene. 6. Acetylene burns ... air ... a brilliant white light. 7. The greatest amount ... oxygen is used ... cutting iron and steel.

Ex. 9. a) Check up if you remember the following:

Прилагательные	Положительная степень	Сравнительная степень	Превосходная степень
Односложные прилагательные	long	long*er*	*the* long*est*
Многосложные прилагательные	difficult	*more* difficult	*the most* difficult
Особые случаи	good bad little much/many far	better worse less more farther/ further	the best the worst the least the most the farthest/ the furthest

b) Translate the following adjectives into English and give their comparative and superlative forms:

новый, хороший, большой, плохой, интересный, теоретический, много, легкий, высокий, маленький

c) Translate the sentences into Russian, paying attention to the adjectives.

1. The Russian language is more difficult than the English language. 2. This work is less important than that work. 3. Lesson 2 is more interesting than Lesson 1. 4. What is the largest city in Russia? 5. Is the Volga longer than the Lena? 6. Which is the oldest building in St. Petersburg University? 7. Which was the most difficult subject for you when you were at school? 8. Who is the oldest in your group? 9. Most oxygen produced for industrial purposes is purer than 99 per cent. 10. Some applications of oxy-acetylene process are better known than others. 11. One of the most spectacular applications of oxygen in industry is for cutting iron and steel. 12. Perhaps you will describe the most recent applications of the oxy-acetylene process. 13. Oxygen is men's best friend.

Ex. 10. Translate the sentences into Russian.

1. He told me that the lecture would begin at 3 p. m. 2. They knew student N was working at the laboratory. 3. As I hadn't read this article before, I went to the reading-room. 4. I thought she would become a good student. 5. When I came to the laboratory, he had already gone home. 6. We were told that even Lavoisier had been interested in oxygen. 7. The teacher explained how the substance had been obtained in his laboratory. 8. The hypothesis was very interesting but we wanted to know how it had been developed. 9. Soddy showed that some radioactive elements had similar behaviour. 10. Mendeleyev predicted that more elements would be discovered and even described their properties. 11. Early chemists thought that water was an element. 12. Their

experiment showed that not all isotopes were stable. 13. When we came in, she had finished her experiment and was analysing the results. 14. Everybody knew that professor N was making experiments on the properties of substances.

Ex. 11. Translate the sentences into English.

1. Кислород уже давно применяется в промышленности. 2. Кислород обычно получают из воздуха путем его сжижения и фракционной перегонки. 3. В техническом отношении этот процесс сложен. 4. Жидкий воздух — это очень холодная смесь жидкого кислорода и жидкого азота. 5. Когда карбид кальция обрабатывают водой, получается ацетилен. 6. В настоящее время кислородно-ацетиленовая сварка и резка металлов применяется почти во всех отраслях промышленности. 7. Огромное количество кислорода используется ежегодно для промышленных целей. 8. Кислород — лучший друг человека. Он послужил спасению жизни многих людей.

Ex. 12. Make up questions to the italicized parts of the sentences.

1. There has been *interest* in oxygen *for several hundred years* (2). 2. *Today* there is practically no industry which *does not use the oxy-acetylene process* (3). 3. *Applications* of *the oxy-acetylene* process are divided into *two* fields — repair and production (3).

Ex. 13. Answer the following questions:

1. Who gave the name to oxygen? When? 2. What can you say about the industrial application of oxygen in the nineteenth century? 3. What industrial application of oxygen is known best of all? 4. In what fields of industry is the oxy-acetylene process used? 5. Why is oxygen called men's best friend?

Section II

Упр. 1. Прочтите заголовок и подзаголовок текста 5 В. Вспомните и скажите, что вы уже знаете по данной теме.

Упр. 2. Назовите значения следующих интернациональных слов:

radiation, ultraviolet, ozone, electric, arc, generation, electrolysis, concentration, efficiency, characteristic, detect, toxicity, molecule, linear, contract, diamagnetic, resonance, electrophilic, mechanistic, biological, effect, vitamin, observation, antioxidant, protection, destructive, elastomer

Упр. 3. Определите значения выделенных слов по контексту. Синонимы в скобках помогут вам.

1. Electrolysis is one of the *common* (usual) methods for obtaining ozone. 2. The ultraviolet radiation *technique* (method) is used when *relatively* (comparatively) low concentrations are obtained. 3. When high-

purity ozone *is desired* (is necessary), liquid ozone is used. 4. When water is boiling, *vapour* is formed. 6. The normal atmospheric *pressure* is 760 mm. 7. The characteristic odour of ozone is detectable by *nose*. 8. This odour *provides* (gives) *a warning* (a signal) of toxicity. 9. On *exposure* to oxygen metals are oxidized. 10. Gaseous ozone *possesses* four resonance structures. 11. Electrophilic nature of ozone is *accounted for* (explained by) this fact.

Слова к тексту:

silent discharge — тихий разряд; **require** — требовать; **environment** — окружающая среда; **pass through a vessel** — проходить через сосуд; **bond** — связь; **rat** — крыса; **undergo** — подвергаться

Text 5 B

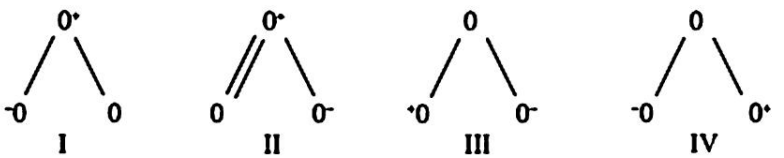
Прочтите текст про себя (контрольное время чтения — 7 минут).

Ozone: Properties, Toxicity, and Applications

Common methods for ozone generation are ultraviolet radiation, silent electric arc discharge and electrolysis. The unltraviolet radiation technique is used only when relatively low concentrations are required, e. g. for environmental study. The electrolysis of water is not widely used because of its low efficiency. So far, the action of silent electric discharge on oxygen is the most common method for the production of ozone. It gives a yield of 6% by weight of ozone.

When high purity or quantity of ozone is desired, it is possible to use liquid ozone. The ozone-oxygen mixture from one of the above methods is passed through a vessel at liquid oxygen temperature (–183°C). Because of the large difference in the vapour pressure of ozone and oxygen, oxygen is pumped off from the mixture whereas ozone is liquefied. Liquid ozone is then vaporized from the concentrated system for further use.

Ozone is a colourless gas with characteristic odour which is detectable by nose and provides a warning of toxic exposure. The ozone molecule is non-linear with a bond angle of 116°. In contrast to oxygen, gaseous ozone is diamagnetic and possesses four resonance structures with (III) and (IV) accounting for its electrophilic nature.



Mechanistic studies of the biological effect of ozone are of particular interest. Vitamin E prolongs the life of rats exposed to ozone. This is based on the observation that the vitamin E-depleted group undergoes a more significant change than the vitamin E-supplemented group in the fatty acid

composition of total lung lipid. Therefore vitamin E, the biological antioxidant, provides protection from ozone toxicity.

Ozone is a particularly destructive substance to rubber and other elastomers.

Упр. 4. Скажите, узнали ли вы что-нибудь новое из этого текста. Что именно?

Упр. 5. Разделите текст на тематические части и озаглавьте каждую часть.

Упр. 6. Скажите, что говорится в тексте:

1) о получении озона; 2) о том, какой метод получения озона является самым распространенным; 3) о том, что собой представляет озон; 4) о том, каково биологическое действие озона.

Упр. 7. Найдите в тексте предложения с описанием строения молекулы озона и переведите их на русский язык.

Section III

Ex. 1. a) Think of the situations when the following or similar expressions may be used:

so do I, so shall I, so is he, etc.; neither do I, neither shall I, neither is he, etc.

b) Translate the following dialogues into Russian:

1. I like reading very much. — So do I. 2. He goes to the cinema once a week. — So does she. 3. They have already had breakfast. — So have we. 4. I don't like examinations. — Neither do I. 5. He doesn't go to the theatre very often. — Neither does his sister. 6. They haven't visited Mendeleyev's museum yet. — Neither have we.

Ex. 2. Translate the sentences into English. Let your fellow students respond to them. Use expressions from exercise 1.

1. Мы знаем много законов химии и физики. 2. Я не помню значения этого слова. 3. Нам нравится читать текст о великих ученых. 4. Мы узнали много интересного о Менделееве. 5. До сих пор я никогда не слышал о Пристли. 6. Он еще не знает, что мы уже работаем в лаборатории. 7. Мне не понравилась последняя лекция по математике.

Ex. 3. Make up sentences or short stories with the following words:

1) oxygen, almost, industry, use, every, field; 2) amount, use, cutting, iron, great, oxygen, steel; 3) oxygen, diseases, amount, ever, use, increasing, treatment; 4) oxy-acetylene, application, know, process, repair, production, field; 5) gas, characteristic, be, ozone, colourless, odour

Ex. 4. Give detailed answers to the following questions:

1. What factors speeded the development of the industrial application of oxygen? 2. How is oxygen produced today? 3. Why has the oxy-acetylene process found wide application? 4. Where else is oxygen used besides in industry?

Ex. 5. Discuss the following topics:

1. Methods of Obtaining Oxygen.
2. The Application of Oxygen.
3. The Difference Between Oxygen and Ozone.

DO YOU KNOW THAT...

In nature ozone is formed from oxygen during lightning discharges, and at altitudes of 10,000–30,000 metres through the action of solar ultraviolet radiation. Ozone removes harmful ultraviolet radiation from sunlight and also absorbs the Earth's own infra-red radiation thus protecting it against cooling. Therefore the ozone belt plays a major role in protecting life on Earth.

Lesson 6

ГРАММАТИКА: Составное именное сказуемое. Общие сведения о неличных формах глагола. Способы выражения предикатива.

Section I

Ex. 1. Pronounce the following words:

a)	al + согласная	[ɔ:l]	call, also, all, small, already, almost, always, ball, salt, although, wall
	al + k	[ɔ:]	walk, chalk
	but:	[æ]	alcohol, alkali, calcium, alchemist
	a	[ɑ:]	sample, example, past, after, answer, ask, half, task, class, grass, glass, pass, vast, mask, fast, last
	but:	[æ]	mass
	wh	[w]	what, while, when, where, which, white, why
	but: wh + o	[h]	who, whose, whole, whom
	w + a	[wɒ]	want, water, wash, was, watch
	w + ar	[wɔ:]	warm, war

b) light [laɪt], ratio ['reɪʃɪəʊ], committee [kə'mɪtɪ], accuracy ['ækjərəsɪ], deuterium [dju(:)'tɪərɪəm], tritium ['trɪtɪəm], nucleus ['nju:klɪəs], ionize ['aɪənaɪz],

covalent [kəʊ'veɪlənt], convenient [kən'vi:njənt], sulphuric [sʌl'fjʊərɪk], cathode ['kæθəʊd], anode ['ænəʊd]

Ex. 2. Read the following words and say what Russian words help to understand their meaning:

mass, individual, calculate, committee, standard, zinc, impress, isotopic, deuterium, tritium, radioactive, stable, ordinary, separation, electrolysis, concentrate, apparatus, proton, ion, sole, neutron, characteristic, general, natural, recombine, line, combination, organic, covalent, type, class, act, negative, molecule, hydride, barium, action, cathode, anode

Ex. 3. Pay attention to the following way of word-building:

основа слова + *-ize* [aɪz] → **глагол**	
summarize, organize, recognize, ionize, revolutionize, generalize	
основа слова + *-ent* →	**существительное, прилагательное**
	student, component, constituent, coefficient, opponent
	different, convenient, intelligent, efficient, violent, evident, constituent
co- + основа слова →	**существительное, прилагательное, глагол**
	co-worker, co-author, co-pupil, co-student, co-reactant, coordination
	covalent, coaxial, coordinate
	coexist, cooperate, coagulate, coordinate

Ex. 4. Compare the meanings of the verb with and without prepositions. Use a dictionary if necessary.

come — come back — come off — come out; decide — decide upon; go — go back — go on — go away — go out — go in for; stand — stand up — stand for; make — make up — make out; find — find out; set — set up; give — give away — give back — give off — give up; get — get off — get out — get together — get up; consist in — consist of; use — use up

Ex. 5. Make up some sentences of your own illustrating different meanings of verbs with and without prepositions. Use the verbs from exercise 4.

Text 6 A

Hydrogen

Hydrogen is the lightest chemical element. Its mass is the unit of measurement for the masses of other elements.

Atomic weight, or mass, was long considered the most important property of an element. By weighing the amounts of individual elements making up a chemical compound and calculating the weights of these ratios

to the weight of hydrogen which will combine with the same elements, it is found that the atomic weights of the other elements are almost, but not quite, whole numbers.

During the nineteenth century a committee of chemists was chosen to decide upon a standard of accuracy for atomic weights. The committee set the atomic weight of oxygen at 16.000 in order to make the atomic weights of other elements come out closer to whole numbers. That change of standards gave hydrogen the weight of 1.008.

Hydrogen was first obtained in 1766 by Sir Henry Cavendish in London. He found that he could get the gas by dissolving zinc, iron or tin in diluted vitriolic acid (H_2SO_4) or spirit of salt (HCl). He discovered that a mixture of hydrogen and common air explodes with a long noise, and he was impressed with the lightness of the gas. He named the gas "inflammable air", the name "hydrogen" (water-former) was given by Lavoisier.

Hydrogen exists in three isotopic forms, known as hydrogen (or protium), deuterium and tritium. Tritium is radioactive, with a short half-life. Deuterium is stable, and occurs in a small amount with ordinary hydrogen. Its compound (D_2O) is known as heavy water. Slight differences between the properties of ordinary water and heavy water allow their separation, notably by electrolysis, in which ordinary water is decomposed and heavy water becomes concentrated in the water left in the apparatus.

The nuclear structure of ordinary hydrogen consists of one proton, the unit of matter. This is the same as a hydrogen ion. An electron as the sole planet in this system completes the structure of hydrogen atom.

The difference between ordinary hydrogen and heavy hydrogen (deuterium) lies in the fact that deuterium has a neutron in the nucleus in addition to the proton. Addition of the neutron adds weight but does not change the chemical characteristics. This is in accordance with a general rule covering structures of elements.

Tritium has a nucleus consisting of one proton and two neutrons.

Hydrogen is given off by some natural gas wells, but it escapes into the upper air. It is not found uncombined on the earth. It is recognized in the stars by its spectrum lines in the light that we receive from them.

In combination with oxygen, in the form of water, and with carbon, in the many organic compounds, hydrogen is one of the most abundant elements on the earth.

Hydrogen combines with other elements and forms different kinds of compounds, some of which ionize in solution, others which are joined with covalent bonds, yielding organic types of compounds.

Although formerly it used to be classed with the alkali metals of Group I in the periodic table, hydrogen acts as a negative part of the molecule when it is in combination with those metals. It forms hydrides which are in general colourless crystals. Similar compounds are formed with calcium and barium of Group II. The hydrides decompose in water,

releasing hydrogen. This property has been used as a convenient way to store hydrogen.

Hydrogen is usually obtained by action of sulphuric acid (H_2SO_4) on zinc. The metal replaces the hydrogen, which bubbles off a gas. Electrolysis of water also liberates hydrogen at the cathode, while oxygen comes off at the anode.

Words and Word-Combinations to Be Memorized

in accordance with, act, action, alkali, anode, apparatus, barium, bond, carbon, choose, come out, combine, concentrate, consider, covalent, decompose, difference, dissolve, electrolysis, electron, explode, form, general, give off, half-life, hydride, hydrogen, ion, ionize, line, measurement, molecule, negative, nucleus, in order to, ordinary, radioactive, separation, spectrum, stable, standard, sulphuric, tin, unit, whole, zinc

Ex. 6. Give the Russian equivalents for the following:

unit of measurement, make up a compound, whole numbers, a committee of chemists, a standard of accuracy, in order to, weigh, dissolve, zinc, iron, a diluted acid, common air, the lightness of the gas, hydrogen, an isotopic form, radioactive, a short half-life, stable, a small amount, ordinary, heavy water, slight difference, electrolysis, apparatus, consist of, the unit of matter, an ion, an electron, complete the structure, the difference lies in the fact, in addition to the proton, change the chemical characteristics, be in accordance with, a rule, a neutron, a proton, to give off, escape into the upper air, in the stars, spectrum lines, different kinds of compounds, in solution, similar compounds, at the cathode, at the anode

Ex. 7. Give the English equivalents for the following:

самый легкий химический элемент, единица измерения, самое важное свойство, целое число, для того чтобы, находить, получить газ, растворить, разбавленная серная кислота, обычный воздух, легкий газ, изотопная форма, радиоактивный, короткий период полураспада, химическое соединение, тяжелая вода, незначительные различия, электролиз, состоять из, находиться в соответствии с, общее правило, линии спектра, в виде воды, соединяться с другими элементами, различные соединения, ионизироваться в растворе, щелочные металлы, гидрид, разлагаться в воде, на катоде, на аноде

Ex. 8. Fill in the blanks with prepositions where necessary.

on, by, of, in, with, between, to, out, at, in order to, for

1. The mass ... hydrogen is the unit ... measurement ... the masses ... other elements. 2. The committee set the atomic weight ... oxygen ... 16.000 to make the atomic weights ... other elements come ... closer ... whole numbers. 3. Hydrogen was given the weight ... 1.008. 4. Hydrogen was obtained ... 1766 ... Henry Cavendish ... London. 5. Cavendish

obtained ... hydrogen ... dissolving ... zinc, iron or tin ... diluted H_2SO_4 or HCl. 6. Cavendish was impressed ... the lightness ... the gas. 7. The name "hydrogen" was given ... Lavoisier. 8. Hydrogen exists ... three isotopic forms. 9. There are slight differences ... the properties ... ordinary water and heavy water. 10. Hydrogen is one ... the most abundant elements ... the earth. 11. Hydrogen combines ... other elements and forms different kinds ... compounds. 12. Some ... the hydrogen compounds ionize ... solution. 13. Hydrogen is usually obtained ... action ... sulphuric acid ... zinc.

Ex. 9. a) Fill in the blanks with *some*, *any*, *no*.

1. There is ... acid in this glass. 2. Have ... more tea, will you? 3. Will you give me ... books now? 4. Sorry, but I have ... pen here. 5. Have ... students come already? 6. They haven't read ... texts yet. 7. Are there ... books on your table? 8. Is there ... difference between oxidation and combustion? 9. There is ... gas in this container, it has escaped. 10. She has ... work to do in the evening.

b) Put the sentences into interrogative and negative forms, give short answers to the obtained questions.

1. There are some students in the room. 2. There are some mistakes in his test-paper. 3. There are some books on the table. 4. There is some information on this process. 5. There is some oxygen in the tube. 6. There are some interesting articles in this journal.

Ex. 10. Translate the sentences into Russian; say what the predicatives are expressed by.

1. Hydrogen is the lightest chemical element. 2. The mass of hydrogen is the unit of measurement for the masses of other elements. 3. The atomic weights of the other elements are almost whole numbers. 4. The atomic weight of oxygen is 16.000. 5. Tritium is radioactive. 6. The formula of heavy water is D_2O. 7. Hydrogen is one of the most abundant elements on the earth. 8. In general hydrides are colourless crystals. 9. The abbreviation of gram is "g". 10. The properties of the elements of Group I are nearly the same. 11. Chemistry is one of the natural sciences. 12. The action of oxygen is to oxidize matter. 13. The purpose of chemical analysis is to determine the composition of compounds. 14. To dilute an acid is to make it less concentrated. 15. Gases are difficult to weigh. 16. Molecules of a gas are free to move in the gas container. 17. On exposure to air active metals become oxidized. 18. A characteristic property of hydrogen is that it exists in three isotopic forms. 19. The chemical behaviour of an element is how it acts toward other elements. 20. The question is how much hydrogen we have obtained.

Ex. 11. Translate the sentences into English.

1. Водород был впервые получен в 1766 году. 2. Его получил Генри Кавендиш, который в то время работал в Лондоне. 3. Он получал

водород растворением цинка, железа или олова в разбавленной серной или соляной кислоте. 4. Комитет решил установить атомный вес водорода 1,008, а кислорода — 16,000. 5. Водород — самый легкий элемент. 6. Название «водород» означает «образующий воду». 7. Ученые знают три изотопных формы водорода. 8. Одна из них (тритий) — радиоактивна, с коротким периодом полураспада. 9. Водород — один из наиболее распространенных элементов на Земле. 10. Гидриды разлагаются в воде, испуская водород.

Ex. 12. Make up questions to the italicized parts of the sentences.

1. Hydrogen is recognized *in the stars* by its spectrum lines in the light *that we receive from them* (2). 2. Hydrogen forms *different kinds of compounds, some of them ionize* in solution (3). 3. *Hydrogen* forms *hydrides* which are in general colourless crystals (2).

Ex. 13. Answer the following questions:

1. What kind of gas is hydrogen? 2. Why was this gas named "water-former"? 3. Why was hydrogen chosen the unit of measurement for the masses of other elements? 4. What are the isotopic forms of hydrogen? 5. What is the structure of a hydrogen ion? 6. Does hydrogen occur free in nature? 7. In what forms does hydrogen mostly occur in nature? 8. How is hydrogen usually obtained?

Section II

Упр. 1. Прочтите заголовок текста 6 В. Скажите, чем, по вашему мнению, он будет отличаться от текста 6 А?

Упр. 2. Назовите значения следующих интернациональных слов:

substance, inorganic, helium, litre, laboratory, reaction, generate, industry, convert, oxide, regenerate, monoxide, special, reason, electronegatively

Упр. 3. Определите значения выделенных слов по контексту. Синонимы в скобках помогут вам.

1. Hydrogen is a very *widely distributed* (abundant) element. 2. *The density* of a substance is $^{m}/_{v}$. 3. The *solubility* of a substance is how readily it dissolves. 4. When the *solubility* becomes greater, we say that it *increases*; when it becomes lower, we say that it *decreases*. 5. The symbols for *sodium* and *lead* are Na and Pb. 6. Alkali metals react very *vigorously* (intensively) with water.

Слова к тексту:

equation — уравнение; **steam** — пар; **heat** — теплота; **ignite** — воспламенить; **filings** — металлические опилки, стружка

Text 6 B

Прочтите текст про себя (контрольное время чтения — 5 минут).

Hydrogen Production

Hydrogen is a very widely distributed element. It is found in most of the substances that constitute living matter, and in many inorganic substances. There are more compounds of hydrogen known than of any other element.

Free hydrogen, H_2, is a colourless, odourless, and tasteless gas. It is the lightest of all gases, its density is about one-fourteenth that of air. Its melting point (–259°C or 14K) and boiling point (–252.7°C) are very low, only those of helium are lower. Liquid hydrogen, with density 0.070 g/cm^{-3}, is the lightest of all liquids. Crystalline hydrogen, with density 0.088 g/cm^{-3}, is also the lightest of all crystalline substances. Hydrogen is very slightly soluble in water; 1 litre of water at 0°C dissolves only 21.5 ml of hydrogen gas under 1-atm pressure. The solubility decreases with increasing temperature, and increases with the increase in the pressure of the gas.

In the laboratory, hydrogen is easily made by the reaction of an acid such as sulphuric acid, H_2SO_4, with a metal such as zinc. The equation for the reaction is:

$$H_2SO_4(aq) + Zn(c) \rightarrow ZnSO_4(aq) + H_2(g).$$

Sometimes hydrogen is prepared by the reaction of some metals with water or steam. Sodium and the other alkali metals react very vigorously with water, so vigorously as to generate enough heat to ignite the liberated hydrogen. An alloy of lead and sodium, which reacts less vigorously, is sometimes used for the preparation of hydrogen.

Much of the hydrogen that is used in industry is produced by the reaction of iron with steam. The steam from a boiler is passed over iron filings heated to a temperature of about 600°C. The reaction that occurs is

$$3Fe(c) + 4H_2O(g) \rightarrow Fe_3O_4(c) + 4H_2(g).$$

After a mass of iron has been used in this way for some time, it is largely converted into iron oxide, Fe_3O_4. The iron can then be regenerated by passing carbon monoxide, CO, over the heated oxide:

$$Fe_3O_4(c) + 4CO(g) \rightarrow 3Fe(c) + 4CO_2(g).$$

There is, of course, nothing special about sodium and iron, except their low cost and availability, that is the reason why they are used for the preparation of hydrogen. Other metals with electronegativity about the same as that of sodium (χ=0.9) react with water as vigorously as sodium, and metals with electronegativity about the same as that of iron (χ=1.8) react with steam in about the same way as iron.

Упр. 4. Скажите, подтвердились ли ваши предположения о содержании текста? В чем?

Упр. 5. Разделите текст на тематические части и озаглавьте каждую часть.

Упр. 6. Скажите, что говорится в тексте:

а) о распространении водорода; б) о физических свойствах водорода.

Упр. 7. Найдите в тексте описание получения водорода в промышленности и переведите этот отрывок на русский язык.

Section III

Ex. 1. Think of the situations when a disjunctive question may be used.

Examples:

1) She is the first-year student, isn't she? — Yes, she is.
You were absent yesterday, weren't you? — Yes, I was.
You have done the exercise, haven't you? — Yes, I have.
2) She hasn't finished her speech, has she? — No, she hasn't.
We haven't yet studied such reactions, have we? — No, we haven't.

Ex. 2. Translate the following questions into English. Let your fellow students respond to them.

1. Мы уже много знаем о водороде и кислороде, не правда ли? 2. Химические свойства щелочных металлов очень интересны, да? 3. Вы еще не закончили свою лабораторную работу, да? 4. Он прав, не правда ли? 5. Эта книга не очень трудна для вас, не правда ли? 6. Вам нравится учиться, правда? 7. Она живет на Среднем проспекте, да? 8. Вы уже видели своего преподавателя сегодня, да? 9. В аудитории № 21 нет сейчас студентов, не правда ли? 10. У нас уже не осталось времени, да?

Ex. 3. Make up sentences or short stories with the following words:

1) hydrogen, element, unit, other, be, it, use, lightest, mass chemical, measurement, element; 2) first, dissolve, iron, Cavendish, obtain, zinc, tin, hydrogen, acid, diluted, sulphuric; 3) be, element, earth, hydrogen, abundant, spectrum, find, line, stars; 4) prepare, some, metal, at present, hydrogen, reaction, water

Ex. 4. Give detailed answers to the following questions:

1. What are the physical properties of hydrogen? 2. In what way was hydrogen obtained first? 3. What are the chemical properties of hydrogen? 4. What do you know about the isotopic forms of hydrogen? 5. What are the ways of obtaining hydrogen?

Ex. 5. Discuss the following topics:

1. The Structure of a Hydrogen Atom.

2. Hydrogen as the Unit of Measurement for the Masses of Other Elements.
3. The Difference Between the Isotopic Forms of Hydrogen.
4. Commercial Obtaining of Hydrogen.

DO YOU KNOW THAT...

In accordance with the theory of acids existing at that time, the result of the reaction of inflammable air and oxygen was expected in the form of an acid, but what Lavoisier obtained was only water. Later he learnt that Henry Cavendish in London had made similar experiments and had obtained water as a result of a combustion of the mixture of "inflammable air" and oxygen. Lavoisier repeated the experiment and made a striking discovery that water was not an element. And he gave "inflammable air" the name of hydrogen.

Lesson 7

ГРАММАТИКА: Составное именное сказуемое. Типы глаголов-связок.

Section I

Ex. 1. Pronounce the following words:

a)

ou, ow под ударением	[aʊ]	now, how, out, about, house, allow, founder, surround, brown, down, account, amount, pronounce, without, cloud, count, loud, thousand
but:	[əʊ]	know, show, low, although, grow, snow
	[ʌ]	country, double, trouble, young
	[u:]	group, through
ow в безударной позиции	[əʊ]	window, yellow
our	[aʊə]	our, hour, sour
but:	[ɔ:]	four, your
oi, oy	[ɔɪ]	boy, join, alloy, point
au, aw	[ɔ:]	law, because, cause, August, autumn, automobile

b) silicon ['sılıkən], dioxide [daı'ɒksaıd], mineral ['mınərəl], quartz [kwɔ:ts], hexagonal [hek'sægənl], identify [aı'dentıfaı], polarization [ˌpəʊləraı'zeıʃn], silicic [sı'lısık], hydroxyl [haıd'rɒksıl], adjacent [ə'dʒeısənt], neighbour ['neıbə]

Ex. 2. Read the following words and say what Russian words help to understand their meaning.

dioxide, mineral, quartz, granite, rotate, polarization, condensation, product, ordinary, position, cubic

Ex. 3. Pay attention to the following way of word-building:

основа слова + *-ness* [nis] → существительное lightness, usefulness, hardness, beautifulness, happiness, whiteness
основа слова + *-ty* [ti] → существительное party, property, speciality, purity, beauty
основа слова + *-fy* [fai] → глагол verify, testify, intensify, signify, identify, simplify

Ex. 4. Find the meaning of the following words in a dictionary. If you can't find the word, try to find its constituent parts and deduce the meaning of the whole word.

hexagonal, widespread, well-formed, right-handed, left-handed, tetrahedron, test-tube, cross-road, test-paper, fellow-student, water-proof, shop-assistant

Ex. 5. Find the meaning of the italicized words in a dictionary and translate the sentences into Russian.

1. Quartz occurs in many *deposits* as well-formed crystals. 2. It also occurs as a crystalline constituent of many *rocks*. 3. The crystals of quartz are left-handed or right-handed by their *face* development. 4. Silicic acid has the property of undergoing condensation very radily with *elimination* of water. 5. Each silicon atom is *surrounded* by four oxygen atoms. 6. The structure of quartz *accounts for* the hardness of the mineral.

Text 7 A

Silicon Dioxide

Silicon is, next to oxygen, the most abundant element in the earth's crust which occurs mostly in the form of oxides. Silicon dioxide (*silica*), SiO_2, occurs in nature in three different crystal forms: as the minerals quartz (hexagonal), *cristobalite* (cubic), and tridymite (hexagonal). Quartz is the most widespread of these minerals; it occurs in many deposits as well-formed crystals, and also as a crystalline constituent of many rocks, such as granite. It is a hard, colourless substance. Its crystals are identified as right-handed or left-handed by their face development

and also by the direction in which they rotate the plane of polarization of polarized light.

The structure of quartz is closely related to that of silicic acid, H_4SiO_4. In this acid silicon has ligancy 4, and is surrounded by a tetrahedron or four oxygen atoms, with one hydrogen atom attached to each oxygen atom. Silicic acid, which is a very weak acid, has the property of undergoing condensation very readily, with elimination of water. If each of the four hydroxyl groups of a silicic acid molecule condenses with a similar hydroxyl group of an adjacent molecule, eliminating water, a structure is obtained in which the silicon atom is bonded to four surrounding silicon atoms by silicon-oxygen-silicon bonds. This process leads to a condensation product with formula SiO_2, since each silicon atom is surrounded by four oxygen atoms, and each oxygen atom serves as a neighbour to two silicon atoms. The structure of quartz and of the other forms of silica is described as consisting of SiO_4 tetrahedra, and each oxygen atom is a corner of two of these tetrahedra. In order to break a crystal of quartz it is necessary to break some silicon-oxygen bonds. In this way the structure of quartz accounts for the hardness of the mineral.

Cristobalite and tridymite are similarly made from SiO_4 tetrahedra fused together by sharing oxygen atoms, with, however, different arrangements of the tetrahedra in space from that of quartz. Tridymite resembles ordinary ice in structure, with silicon atoms in the oxygen-atom positions; cristobalite similarly resembles cubic ice.

Words and Word-Combinations to Be Memorized

account for, adjacent, arrangement, attach, closely, crystalline, deposit, dioxide, formula, fuse, granite, group, hydroxyl, identify, mostly, neighbour, position, quartz, be related to, serve, share, silicon, similarly, since, space, surround, together, undergo, weak

Ex. 6. Give the Russian equivalents for the following:

next to oxygen, mostly, the most widespread mineral, deposit, a well-formed crystal, constituent, a hard substance, identify something, right-handed, left-handed, rotate, the plane of polarization, polarized light, be closely related to, be surrounded by, a weak acid, undergo condensation, a hydroxyl group, an adjacent molecule, be bonded to, lead to, condensation product, neighbour, in order to break a crystal, account for, be fused together, share oxygen atoms, ordinary ice, resemble smth. in structure

Ex. 7. Give the English equivalents for the following:

диоксид кремния, встречаться в природе, вращать плоскость поляризации, структура кварца, быть тесно связанным с, окружать, присоединить к атому, очень слабая кислота, подвергаться конденсации, очень легко, каждая из гидроксильных групп, молекула кислоты, связь, вести к, продукт конденсации, разорвать связь, таким образом,

объяснять, твердость минерала, делить между собой атомы кислорода, различные расположения в пространстве, быть похожим на лед по структуре

Ex. 8. Fill in the blanks with prepositions where necessary.

of, for, in, with, to, by

1. Silicon occurs mostly ... the form ... oxides. 2. Silicon dioxide occurs ... nature ... three different crystal forms. 3. The structure of quartz is closely related ... that ... silicic acid. 4. Silicic acid has the property ... undergoing condensation ... elimination ... water. 5. ... SiO_2 each silicon atom is surrounded ... four oxygen atoms. 6. To break a crystal ... quartz it is necessary to break ... some silicon-oxygen bonds. 7. The structure ... quartz accounts ... the hardness ... the mineral.

Ex. 9. Check up if you remember the following:

a) Words of the Greek or Latin origin form their plural by changing the suffixes in the following way:

Singular	—	Plural	Singular	—	Plural
-a	→	*-ae*	formula	→	formulae
-um	→	*-a*	datum	→	data
-on.	→	*-a*	phenomenon	→	phenomena
-us	→	*-i*	radius	→	radii
-is	→	*-es*	hypothesis	→	hypotheses
-x	→	*-ces*	index	→	indices

The following nouns have the same forms of their singular and plural:

apparatus, means, news, series, species

b) Make up singular-plural pairs from the list below:

quanta, maximum, analyses, vacua, axis, maxima, nuclei, analysis, apparatus, criteria, nucleus, quantum, matrix, crisis, theses, crises, moments, axes, syntheses, criterion, thesis, momentum, synthesis, vacuum, matrices, apparatus

c) Translate the sentences into Russian paying attention to the italicized nouns.

1. Until about 1860 the majority of chemists used *formulae* merely as a convenient representation of organic compounds. 2. We heard a very good *news* today. 3. The *phenomenon* of attraction of opposites interested many philosophers. 4. Neutrons are also the most effective *means* of producing artificial radioactivity. 5. Avogadro's *hypothesis* was originally advanced to explain Gay-Lussac's law of combining volumes. 6. There is some new *apparatus* on that table. 7. To analyse *species* is to identify their constituent elements. 8. There are eighteen elements in this *series*.

Ex. 10. Translate the sentences into Russian paying attention to link-verbs.

1. Quartz is a hard, colourless substance. 2. Silicic acid is a weak acid. 3. To break a crystal of quartz is to break some silicon-oxygen bonds. 4. Silicon mostly occurs combined. 5. As chemistry developed, some hypotheses became laws. 6. An acid turns blue litmus red. 7. Water turns into ice at 0°C. 8. Only a few of metals occur free in nature. 9. At boiling point, water turns into vapour. 10. The students remained silent. 11. The hypothesis holds true under different conditions. 12. The solution turns yellow on standing. 13. He felt sorry for what he had done. 14. The predictions proved right. 15. It was 5 p. m. and the classes were over. 16. Dalton's atomic theory became one of the foundations of modern chemistry.

Ex. 11. Translate the sentences into English.

1. Кремний — один из самых распространенных элементов на земле. 2. Кремний встречается главным образом в виде диоксида кремния. 3. Кварц — это твердое бесцветное вещество. 4. Твердость кварца объясняется его структурой. 5. Структура кварца тесно связана со структурой кремнекислоты. 6. Кремнекислота — очень слабая кислота, она легко подвергается конденсации. 7. В кремнекислоте кремний окружен четырьмя атомами кислорода и к каждому атому кислорода присоединен атом водорода.

Ex. 12. Make up two or three questions to the italicized parts of the sentences.

1. Quartz *crystals* are identified as *right-handed* or *left-handed* (2). 2. *The structure* of quartz and of *other* forms of silica is described *as consisting of SiO_4 tetrahedra* (3). 3. *In order to break a crystal of quartz* it is necessary to break some *silicon-oxygen* bonds (2).

Ex. 13. Answer the following questions:

1. In what state does silicon occur? 2. What are the physical properties of quartz? 3. How is the hardness of quartz accounted for? 4. What do you know about silicic acid? 5. Describe the molecular structure of SiO_2.

Section II

Упр. 1. Прочтите заголовок текста 7 В. Скажите, знаете ли вы что-нибудь по этому вопросу.

Упр. 2. Назовите значения следующих интернациональных слов:

essential, primitive, organism, normal, laboratory, calcium, associate, mineralization, physiological, function, phosphorus, vitamin, vanadium, effect, pigmentation, observation, support, effective, litre, evolution, skeletal, role, toxicity

Упр. 3. Определите значения выделенных слов по контексту. Синонимы в скобках помогут вам.

1. Until now there has been no *proof* (evidence) for the importance of silicon in the life of animals or men. 2. Silicon is *required* (necessary) for normal growth of living beings. 3. *Previous* (early) laboratory studies showed several ways of obtaining hydrogen. 4. In the earliest *stages* (steps) of calcification in bones their *calcium content* (amount of calcium) is very low. 5. When a reaction proceeds quickly, we usually say that its *rate* is high. 6. The symbols for *magnesium* and *fluorine* are Mg and F. 7. Other observations support the previous *conclusion* that silicon is essential. 8. Silicon is present in animal matter in small *quantities*. 9. Two is the *average* between 1 and 3.

Слова к тексту:

vital — жизненный; **except** — кроме; **suggest** — наводить на мысль; **bone** — кость; **especially** — особенно; **plant** — растение; **egg** — яйцо; **bird** — птица; **appreciable** — ощутимый; **implications** (*pl.*) — толкования; **participant** — участник

Text 7 B

Прочтите текст про себя (контрольное время чтения — 6 минут).

Silicon: an Essential Element for Life Processes

Until now there has been no proof that silicon plays any definite role in vital processes in animals or men. Scientists believed that it was nonessential except in certain primitive organisms. But later it was shown that silicon is required for normal growth and development of living beings.

Previous laboratory studies had suggested a possible role for silicon in bone formation, especially in young bone. In the earliest stages of calcification in bones, when their calcium content is very low, there is a direct relationship between silicon and calcium. Silicon is associated with calcium and increases the rate of bone mineralization. A relation has also been established between silicon, magnesium and fluorine in the formation of bones.

Some studies have also suggested the possibility that silicon has a physiological function. In addition to calcium, phosphorus, magnesium, iron and certain vitamins, silicon, along with tin, vanadium, and fluorine, has an effect of pigmentation.

Other observations support the previous conclusion that silicon is essential. The level of silicon effective for normal growth and development is of the order that is present in plant and animal food-stuff. Silicon is present in animal matter. The eggs of birds and milk have small but appreciable quantities. The blood of man averages about 5 mg of silicon per litre.

The discovery of the essential role of silicon in life processes has many implications, first, from an evolutionary point of view, since silica performs a skeletal role in some primitive organisms, and, second, because, although great importance has been attached to the study of toxicity of silica, it has also been found that silicon itself can be considered as an important participant in normal metabolism.

Упр. 4. Скажите, узнали ли вы что-нибудь новое о кремнии. Что именно?

Упр. 5. Разделите текст на тематические части и озаглавьте каждую часть.

Упр. 6. Скажите, что говорится в тексте:

1) о роли кремния в жизни живых организмов; 2) о физиологической функции кремния; 3) о том, какое количество кремния необходимо для нормального роста и развития; 4) о функции кремния в образовании костей.

Упр. 7. Найдите в тексте и переведите на русский язык предложения, где приводятся толкования роли кремния в жизненных процессах.

Section III

Ex. 1. Think of the situations when the following expressions may be used:

I'd like to...; what about you; the same to you

Examples:

1. **I'd like to go to the cinema today, and what about you?**
2. **I wish you the best of everything. — The same to you.**

Ex. 2. Translate the following into English. Let your fellow-students respond to your statements or questions. Use the expressions from exercise 1.

1. Я еще не знаю расписание на следующую неделю, а ты? 2. Мне хотелось бы сегодня поработать, давай встретимся завтра. 3. Завтра выходной, желаю тебе хорошо отдохнуть. 4. Я никогда не знал, что в молоке есть кремний, а ты? 5. Он хотел бы сдать экзамен завтра. 6. Петров сдал уже все экзамены, а ты? 7. Лекции профессора Николаева очень интересны, я хотел бы записывать их полностью, но я пишу медленно. 8. Мне хотелось бы понять, почему кварц такой твердый. 9. Желаю тебе хорошо сдать все экзамены.

Ex. 3. Make up sentences or short stories with the following words:

1) dioxide, nature, three, crystal, silicon, occur, different, form; 2) be, widespread, silicon, quartz, most, mineral; 3) quartz, structure, hardness, mineral, account for; 4) play, important, silicon, vital, role, animal, men, process; 5) be present, silicon, appreciable, food-staff, amount

Ex. 4. Give detailed answers to the following questions:

1. In what form does silicon occur in nature? 2. What is the structure of quartz; what are the properties of this mineral? 3. What is the structure of silicic acid; what are the properties of this acid? 4. In what living processes in animals or men does silicon take part?

Ex. 5. Discuss the following topics:

1. An Abundance of Silicon.
2. The Structure of SiO_2 Molecule.
3. Properties and Structure of Quartz, Cristobalite and Tridymite.
4. The Role of Silicon in Living Processes.

DO YOU KNOW THAT...

Although the compounds of silicon have been used for many centuries, the element was prepared only at the beginning of the 19th century. At present, there are several methods of obtaining silicon. One of them is to heat silicon dioxide with magnesium:

$$SiO_2 + 2Mg = Si + 2MgO.$$

One way of preparing silicon commercially is by reducing SiO_2 with carbon in an electric furnace.

Lesson 8

ГРАММАТИКА: Составное глагольное сказуемое. Формы инфинитива и их значения. Модальные глаголы и их заместители.

Section I

Ex. 1. Pronounce the following words:

a)

-gh в середине и в конце слова не произносится but: [f]		high, light, slight, night, might, weigh, weight, though, through, although, thorough, thoroughly, brought tough, enough, laugh
s	[s]	sit, such, solution, mass, serve, student, list, substance, selenium, discover, sister, sulphur, less, same, several, just, so, similar
	[z]	is, as, has, these, boys, ores, please, pens, observe
sh	[ʃ]	she, shall, shop, should, show, reddish, share, short

b) nevertheless [ˌnevəðəˈles], giant [ˈdʒaɪənt], tellurium [təˈljʊərɪəm], selenium [sɪˈliːnɪəm], variety [vəˈraɪətɪ], curious [ˈkjʊərɪəs], conductivity [ˌkɒndʌkˈtɪvɪtɪ], colloid [ˈkɒlɔɪd], gelatin [ˈdʒelətɪn], hydrazine [ˈhaɪdrəˌziːn], hydrate [ˈhaɪdreɪt], suspension [səsˈpenʃn]

Ex. 2. Read the following words and say what Russian words help to understand their meaning:

elementary, interesting, giant, valence, allotropic, characteristic, variety, electrical, condition, colloid, gram, gelatin, hydrazine, hydrate, minute, observe, protective, serve, suspension

Ex. 3. Pay attention to the following way of word-building:

red + *-ish* → reddish (красн-*ый* + *-оват*(*ый*) = *красноватый*) greenish, bluish, yellowish, pinkish, brownish
основа слова + *-ful* → прилагательное useful, beautiful, helpful, careful, truthful, thankful, peaceful, successful
основа слова + *-sion* [ʃn], [ʒn] → существительное conversion, suspension, inversion; division, explosion, corrosion

Ex. 4. Arrange the following words in the alphabetic order and find their meaning in a dictionary:

textbooks, nevertheless, ores, infer, alike, pieces, coating, flame, peculiar, curious, varies, prolong

Ex. 5. Find the meaning of the words or expressions with the italicized words in a dictionary and translate the sentences into Russian.

1. Selenium is well *worth* studying. 2. It is *worthwhile* reading this textbook. 3. We *compared* the atomic weights of many elements. 4. Selenium has an atomic weight of 78.96 as *compared* with 32 for sulphur. 5. His *respect* to his teachers was great. 6. In this *respect* selenium differs from sulphur.

Text 8 A

Selenium

The element selenium usually receives scant* attention in elementary textbooks, probably because it is of little importance commercially. Nevertheless, it is an interesting substance and well worth studying.

Selenium was discovered by the Swedish giant among chemists, Berzelius.

The element is not abundant, but it is to be found in various ores.

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* scant — скудный

Selenium is the sister element of sulphur, forming with tellurium the elements occurring in Group VI. It has an atomic weight of 78.96 as compared with 32 for sulphur. From the fact that the atomic weight is more, we may infer that selenium should be less active than sulphur. Its valences are: +2, +4, and +6, the same as those of sulphur. It can be found in several allotropic forms, just as sulphur does. It will be helpful to remember that the two elements are very much alike in their chemical properties and so the reactions of sulphur are similar to those of selenium.

A piece of amorphous selenium is rather hard and quite brittle, just as sulphur is. The dark colour of the element, the silver-grey coating on its surface are characteristic. Another variety of the element is red.

The element is both odourless and tasteless. It burns as readily as sulphur does, with a reddish-blue flame and the peculiar odour. In working with selenium, beware* of the odour of its hydrogen compound; it is worse than that of hydrogen sulphide.

One curious property of selenium should be mentioned. The substance varies in its electrical conductivity according to the amount of light that falls upon it. We should remember that sulphur is a nonconductor. An experiment shows that selenium differs in this respect.

Under proper conditions selenium can form a colloid. One gram of selenium dioxide is dissolved in 500 ml of water. To 50 ml of this solution we add, after heating, 10 ml of a one-percent solution of gelatin, and then, drop by drop, 60 ml of hydrazine hydrate (1:2,000 of water). We must remember to keep it just below the boiling point for 16 minutes. The beautiful peach-pink** colour of the colloid is to be observed. The colloid can be made without gelatin, but the protective colloid serves to prolong the life of the colloidal suspension.

Words and Word-Combinations to Be Memorized

according to, alike, be alike, allotropic, amorphous, another, coating, colloid, compare, as compared, condition, conductivity, conductor, differ, drop, electrical, elementary, fall, few, a few, gram, heat, hydrate, importance, keep, mention, nevertheless, ore, piece, proper, quite, rather, readily, in this respect, selenium, several, silver, sulphur, sulphide, surface, suspension, tellurium, textbook, variety, vary, be worth (while).

Ex. 6. Give the Russian equivalents for the following:

elementary textbooks, receive attention, be of importance, probably, nevertheless, because, be worth studying, among, in various ores, the sister element, as compared with, be less active, be more active, several allotropic forms, just as, remember, be very much alike, be similar to, amorphous

* beware — остерегаться

** peach-pink — персиково-розовый (*цвет*)

selenium, piece, rather hard, dark colour, the silver-grey coating, on the surface, another variety of, both... and..., burn readily, be worse than, mention, electrical conductivity, according to, fall upon smth., remember, be a conductor, be a nonconductor, differ in some respect, under proper conditions, heating, a one-percent solution, drop by drop, the protective colloid, prolong the life

Ex. 7. Give the English equivalents for the following:

вероятно, иметь большое промышленное значение, тем не менее, интересный, среди химиков, в различных рудах, атомный вес, по сравнению с, быть более (менее) активным, такая же валентность, несколько аллотропных форм, быть полезным, быть очень похожим, довольно твердый, темный цвет, покрытие на поверхности, как... так и..., при работе с, в соответствии с, непроводник, в этом отношении, при надлежащих условиях, однопроцентный раствор, защитное покрытие, продлить жизнь

Ex. 8. Fill in the blanks with prepositions where necessary.

in, under, of, by

1. Selenium is ... little importance commercially. 2. It was discovered ... Berzelius. 3. This element is found ... various ores. 4. The valences ... selenium are the same as those ... sulphur. 5. It can be found ... several allotropic forms. 6. It is helpful to remember that selenium and sulphur are very much ... alike ... their chemical properties. 7. ... proper conditions selenium can form a colloid.

Ex. 9. a) Check up if you remember the following:

few *— немногие, немного, мало;* ***a few*** *— несколько* употребляются с исчисляемыми существительными
little *— немного, мало;* ***a little*** *— немного* употребляются с неисчисляемыми существительными

few books, little milk, a little water, a few pens, a few tables, little acid, few students, a little coffee

b) Translate the sentences into English.

1. В стакане мало воды. Принеси еще, пожалуйста. 2. Уже поздно, но в лаборатории работают несколько студентов. 3. Только немногие студенты ответили на все вопросы. 4. Вы знаете слишком мало об этом явлении. 5. На столе лежат несколько журналов. В одном из них — статья о Полинге. 6. В вашей работе есть несколько ошибок. Попробуйте их исправить. 7. Студенты нашей группы сейчас в библиотеке, они занимаются там уже несколько часов. 8. У меня мало денег, я не могу купить этот словарь сейчас. 9. Несколько студен-

тов в этой группе хорошо читают по-английски. 10. Вы мало работаете, вам надо работать больше.

c) Fill in the blanks with *few, a few, little, a little.*

1. Only ... information is available about iodine pentafluoride as a solvent. 2. ... drops of concentrated HNO_3 were added to a decomposing melt containing chloride. 3. There is ... possibility that such ions can be produced under these conditions. 4. ... very interesting reactions have been shown at the lecture. 5. There are ... published papers on the preparation and properties of inorganic deuterium compounds. 6. High-temperature reactions of polonium have been ... studied. 7. There can be ... doubt that the term "chemical structure" was used for the first time in 1861 by Butlerov. 8. ... of these results have been reported previously.

Ex. 10. Translate the sentences into Russian, paying attention to modal verbs.

1. Selenium may be found in various ores. 2. We are able to describe the properties of any element looking at the periodic table. 3. Selenium can occur in several allotropic forms. 4. Chemists must remember that sulphur is a nonconductor of electricity. 5. Under proper conditions we may obtain a colloid. 6. He must be able to explain the difference between organic salts and inorganic salts. 7. Students have to understand reactions well. 8. Matter and its transformations must be studied by specialists. 9. Working in our laboratory, we can change the state of substances. 10. The experiment is to be started at once. 11. You needn't heat the substances, the reaction proceeds fast enough. 12. You should know the properties of the substances if you have to work with them. 13. Sometimes we needn't accelerate the reaction. 14. Mendeleyev was able to predict in advance the existence and properties of yet undiscovered elements. 15. Mendeleyev couldn't be present at the meeting of Russian chemical society and had to ask Menshutkin to read the paper for him. 16. The "zero" group could be added to the periodic table only after the discovery of inert gases. 17. We should clean the glassware before working with it. 18. Lavoisier was able to establish his theory of combustion on the basis of the experimental results of Priestley, Sheele and others. 19. The hydrides can decompose in water, releasing hydrogen. 20. You should remember that the yield in this reaction is good only if it goes to completion. 21. Students will be able to identify substances after some practice in qualitative analysis.

Ex. 11. Translate the sentences into English.

1. Селен не имеет большого промышленного значения. 2. Хотя селен не очень широко распространен, его можно найти в различных рудах. 3. Мы можем сказать, что атомный вес селена почти в два раза выше по сравнению с серой. 4. Из его положения в периодической таблице мы можем сделать вывод, что селен должен быть менее активным, чем сера. 5. Сера и селен очень похожи, и потому реакции

серы похожи на реакции селена. 6. Селен без запаха и без вкуса, но может иметь несколько вариаций по цвету. 7. При работе с селеном следует помнить, что у его соединения с водородом запах хуже, чем у сероводорода. 8. Удельная электропроводность селена может изменяться в соответствии с количеством падающего на него света...

Ex. 12. Make up questions to the italicized parts of the sentence.

1. *Selenium was discovered* by the Swedish chemist *Berzelius in 1817* (4). 2. A piece of amorphous *selenium* is rather hard and quite brittle, *just as sulphur* is (2). 3. *The protective colloid* can prolong *the life* of the colloidal suspension *of selenium* (3).

Ex. 13. Answer the following questions:

1. Why is there only little information about selenium in elementary textbooks? 2. Why are the properties of selenium and sulphur alike? 3. What are the physical properties of selenium? 4. What can you say about electrical conductivity of selenium and sulphur? 5. In what way can we prepare a colloid with selenium? 6. How can the life of this colloid be prolonged?

Section II

Упр. 1. Прочтите заглавие текста 8 В. О чем, по вашему мнению, будет идти речь в этом тексте?

Упр. 2. Назовите значения следующих интернациональных слов:

metal, selenide, proportion, material, action, chlorine, permanganate, cadmium, cobalt, nickel, zinc, product, process, contain

Упр. 3. Определите значения выделенных слов по контексту. Синонимы в скобках помогут вам.

1. The atomic weight of selenium is *approximately* (about) 79. 2. When H_2SO_4 is to be diluted with water, it must be *poured* into *an excess* (greater amount) of water. 3. Some reactions with concentrated sulphuric acid *proceed* quickly when they are heated. 4. When selenious acid is *treated with* (acted upon by) chlorine, selenic acid is produced. 5. When hydrogen selenide forms, it *bubbles* (passes) into the liquids in the various *bottles* (containers for liquids). 6. The symbols Pb, Cu, K, As and Sb stand for *lead, copper, potassium, arsenic* and *antimony*. 8. We obtained the product *somewhat* (to some extent) heavier than in the previous reaction.

Слова к тексту:

grind — измельчать; **powder** — порошок; **mortar** — ступа; **dust** — пыль; **dry** — сухой; **vigorously** — бурно; **remove** — удалять; **lump** — кусок; **transfer** — перемещать; **flask** — колба; **connect** — соединять; **flue** — газоход

Text 8 B

Прочтите текст про себя (контрольное время чтения — 5 минут).

Selenium Compounds

The element (selenium) can combine with the metals, just as sulphur can, forming selenides. Let us grind some selenium to powder in a mortar. After that, we should take 10 grams of this powder and grind it with 7 grams of iron dust, a proportion of 80 and 56, the approximate atomic weight ratio of the two elements. Then, we must pour the well-mixed material into a dry test-tube and heat it. Ferrous selenide is formed, the action proceeds somewhat less vigorously than that between iron and sulphur. When the tube has cooled somewhat, we can break it open and remove a grey-black product which much resembles ferrous sulphide. Selenium will unite similarly with zinc and with other metals such as copper and lead.

Selenium dioxide may be formed by the combustion of the element. The dioxide is white and can dissolve readily in water to form selenious acid just as sulphur dioxide dissolves to form sulphurous acid:

$$H_2O + ScO_2 \rightarrow H_2ScO_3.$$

When selenious acid is treated with chlorine or potassium permanganate, selenic acid is produced; the process, of course, can be called oxidation, the reaction proceeds just as it does with sulphurous acid. Small lumps of ferrous selenide are transferred to a small flask connected to a train of bottles containing solutions of a number of different metallic salts, for example, those of cadmium, cobalt, nickel, arsenic, and antimony. Any excess of gas which may escape is led into the flue. Add some hydrochloric or sulphuric acid to the material in the flask, and presently hydrogen selenide forms and bubbles into the liquids in the various bottles. Various selenides can be formed.

Упр. 4. Действительно ли текст 8 B содержит ту информацию, которую вы ожидали в нем найти? Скажите, что было для вас новым.

Упр. 5. Разделите текст на тематические части и озаглавьте каждую часть.

Упр. 6. Скажите, что говорится в тексте:

1) о способности селена реагировать с металлами; 2) о реакции селена с железом; 3) об образовании диоксида селена; 4) об образовании селенистой кислоты; 5) о получении селеновой кислоты.

Упр. 7. Найдите в тексте отрывок, где описывается получение селенида водорода; переведите его на русский язык.

Section III

Ex. 1. Think of the situations when the following expressions may be used:

be going to*; *be worth* (*while*)** + существительное или герундий; ***be used to

Examples:

1. I'm going to finish this work at home.
2. The book is worth reading, but it is difficult to get it.
3. He is used to doing everything quickly.

Ex. 2. Translate the sentences into English, using expressions from exercise 1.

1. Я не собираюсь делать домашнее задание сегодня. Уже поздно. 2. Я не буду заниматься иностранным языком регулярно. 3. Она привыкла вставать рано. 4. Есть студенты, которые привыкли получать хорошие оценки. 5. Он начнет реакцию заново, реагент был недостаточно чистый. 6. Она говорила, что собирается на этот фильм. 7. Мы не привыкли переводить текст без словаря. 8. Стоит научиться писать сразу без ошибок, не придется тратить время на переписывание. 9. Он не привык к таким запахам. 10. Свойства некоторых соединений стоит запоминать. 11. Сейчас эту статью читать не стоит, она будет для вас трудна.

Ex. 3. Make up sentences or short stories with the following words:

1) element, importance, abundant, little, commercial, selenium, be; 2) selenium, alike, property, atomic sulphur, be, weight, greater; 3) can, several, form, selenium, find, allotropic; 4) odourless, selenium, be, both... and..., tasteless, in colour, or, hard, red, dark, may; 5) metal, selenium, combine, form, can, selenides

Ex. 4. Give detailed answers to the following questions:

1. What are the physical properties of selenium? 2. What do you know about chemical properties of selenium? 3. In what respect are selenium and sulphur alike? Why? 4. What selenium compounds do you know? 5. What methods of the preparation of selenides do you know?

Ex. 5. Discuss the following topics:

1. An Abundance of Selenium and Its Compounds.
2. The Similarity of the Properties of the Elements Occurring in Group VI.
3. The Description of the Properties of Selenium.
4. Selenium Compounds.

DO YOU KNOW THAT...

In 1817 Berzelius managed to obtain a brown-red powder. It burned like sulphur. He established that it was a new element. He remembered the

other element with the similar properties — tellurium which has been given its name in the honour of the earth (from Greek "tellus" meaning "earth"). He decided to name the newly-discovered element in honour of the moon, that is why it is called selenium.

Lesson 9

ГРАММАТИКА: Выражение вероятности действия при помощи модальных глаголов.

Section I

Ex. 1. Pronounce the following words:

a)

g	[g]	go, green, agree, flag, game, garden, glass, good, great, grey, grow, gram, gas, group, organic, negative
g + e, i, y	[dʒ]	agent, gentle, giant, age, change, general, arrange, genius, hydrogen, halogen, oxygen, large, gymnasium, gyration, gypsum
but:	[g]	give, get, girl, together
ng	[ŋ]	long, strong, among, young, interesting, coating, according, prolong
nk, nc	[ŋk]	pink, drink, think, thank, distinct
qu	[kw]	question, quick, quiet, quarter, quite, quartz, require, liquid, equipment, quantity
que	[k]	u'nique, tech'nique

b) chlorine [klɔ:'rɪn], hydrochloric ['haɪdrəʊ'klɒrɪk], iodate ['aɪədeɪt], iodine ['aɪədi:n], alcohol ['ælkəhɒl], halogen ['hælədʒən], saltpeter ['sɔ:lt,pi:tə], violet ['vaɪəlɪt], triiodide [traɪ'aɪədaɪd]

Ex. 2. Read the following words and say, what Russian words help to understand their meaning.

halogen, unique, molecule, chlorine, manufacture, electrolysis, chloride, bromine, effect, agent, iodine, ion, iodate, concentrate, lustre, violet, chloroform, indicate, alcohol

Ex. 3. Pay attention to the following way of word-building:

a)

основа слова + *-ine* [i:n] → **существительное, глагол**
chlorine, bromine, iodine, hydrazine, examine, determine

основа слова + *-ine* [aɪn] → **прилагательное**
crystalline, alkaline

dis- + основа слова → **придает отрицательное значение, указывает на лишение, отделение, разделение**
discover, dissolve, disappear, disperse, disadvantage, disagreeable, disintegrate

b)

Приставки, обозначающие количество			
mon-	[mɒn]	'one'	monoxide
uni-	[ju:nɪ]		univalent
di-	[daɪ]	'two'	dioxide
bi-	[baɪ]		bicarbonate
tri-	[traɪ]	'three'	triiodide
tetra-	['tetrə]	'four'	tetrachloride
pent-	[pent]	'five'	pentoxide
per-	[pɔ]	'more'	perchloric (acid)
multi-	[mʌltɪ]	'many'	multicoloured

Ex. 4. Determine what part of speech the following words belong to and find their meaning in a dictionary.

undergo, touch upon, irritate, volatile, disagreeable, saltpeter, lustre, pain, sore, spill, skin, throat, Chile, tincture, hydrochloric, treat with, brine, gentle, keep

Ex. 5. Define the meaning of the italicized words.

1. *Oil* is called petroleum by the English. 2. Olive *oil* is used for cooking. 3. Iodine is an almost black crystalline solid with a slightly metallic *lustre*. 4. A beautiful *lustre* was hanging in the room. 5. Men are usually *stronger* than women. 6. A *strong* solution of sodium chloride was prepared.

Text 9 A

The Halogens

Halogens may have interested chemists since early times, for they possess unique properties. They must have interested scientists as all of them, F_2, Cl_2, Br_2 and I_2, consist of diatomic molecules. We are going to touch upon some of their properties in what follows.

Chlorine (from Greek "chloros", greenish-yellow), the most common of the halogens is a greenish-yellow gas with a sharp irritating odour. It

was first made by the Swedish chemist K. W. Scheele in 1774, by the action of manganese dioxide on hydrochloric acid. It is now manufactured on a large scale by the electrolysis of a strong solution of sodium chloride.

The element bromine (from Greek "bromos", stench) occurs in the form of compounds in small quantities in seawater and in natural salt deposits. It is an easily volatile, dark reddish-brown liquid with a strong disagreeable odour and an irritating effect on the eyes and throat. It may produce painful sores when spilled on the skin. The free element can be made by treating a bromide with an oxidizing agent, such as chlorine.

The element iodine (from Greek "iodes", violet) occurs as iodide ion, I^-, in very small quantities in seawater, and, as sodium iodate, $NaIO_3$, in deposits of Chile saltpeter. It is made commercially from sodium iodate obtained from saltpeter, from kelp, which concentrates it from seawater, and from oil-well brines.

The free element is an almost black crystalline solid with a slightly metallic lustre. On gentle warming it gives a beautiful blue-violet vapour. Its solutions in chloroform, carbon tetrachloride, and carbon disulphide are also blue-violet in colour, indicating that the molecules I_2 in these solutions closely resemble the gas molecules. The solutions of iodine in water containing potassium iodide and in alcohol (tincture of iodine) are brown; this change in colour suggests that the iodine molecules have undergone chemical reaction in these solutions. The brown compound KI_3, potassium triiodide, is present in the first solution, and a compound with alcohol in the second.

Words and Word-Combinations to Be Memorized

alcohol, bromine, chloride, chlorine, common, diatomic, follow, be going to, halogen, hydrochloric acid, iodide, iodine, lustre, manganese, oil, possess, potassium, produce, quantity, on a large scale, sharp, sodium, suggest, tincture, touch, treat, unique, volatile

Ex. 6. Give the Russian equivalents for the following:

since early times, interest smb., possess unique properties, diatomic molecules, be going to, greenish-yellow, a sharp irritating odour, hydrochloric acid, be manufactured on a large scale, a strong solution, occur in the form of compounds, a small quantity, natural salt deposits, be volatile, treat smth. with an oxidizing agent, a black crystalline solid, a slightly metallic lustre, on warming, resemble gas molecules, undergo chemical reaction, be present in solution

Ex. 7. Give the English equivalents for the following:

галоген, состоять из двухатомных молекул, соляная кислота, в больших масштабах, электролиз раствора, раствор хлорида натрия, в морской воде, быть летучим, обладать уникальными свойствами,

окислитель, встречаться, в очень малых количествах, получать из морской воды, элемент в свободном состоянии, кристаллическое твердое вещество, металлический блеск, раствор йода в спирте, подвергаться реакции, находиться в растворе, предполагать (наводить на мысль)

Ex. 8. Fill in the blanks with prepositions where necessary.

in, of, with, on, by

1. All the halogens consist ... diatomic molecules. 2. The most common ... the halogens is chlorine. 3. Chlorine was first made ... the action ... manganese dioxide ... hydrochloric acid. 4. It was obtained by K.W. Scheele ... 1774. 5. Now chlorine is manufactured ... a large scale ... the electrolysis ... a strong solution ... sodium chloride. 6. Bromine occurs ... the form of compounds ... small quantities. 7. Bromine has an irritating effect ... the eyes and throat. 8. Iodine is an almost black crystalline solid ... a slightly metallic lustre. 9. The I_2 molecules ... the solutions ... chloroform, carbon tetrachloride and carbon disulphide closely resemble the gas molecules. 10. The solution iodine ... alcohol is brown ... colour.

Ex. 9. a) Check up if you remember the following:

much *far* *a great deal* *still*	+	сравнительная степень прилагательного или наречия	→	*гораздо* *намного* *значительно* *еще*

much darker, far less abundant, still harder, a great deal more, much lighter, much more beautiful, far less active

b) Translate the sentences into Russian.

1. The first solution of sodium chloride is much stronger than the second solution. 2. Fluorine is a great deal more active than the other halogens. 3. Iodine is much heavier than bromine. 4. A surface coating protects some compounds from still further oxidation. 5. Potassium is much lighter than rubidium, and sodium is still lighter. 6. Amorphous boron is much more reactive chemically than is the harder, more expensive crystalline variety. 7. The nucleus of an atom is much smaller than is the atom itself. 8. Antimony is much more metallic in appearance and in properties than either phosphorus or arsenic. 9. Studies of crystal chemistry have attracted much greater interest during the last decade than ever before. 10. Carbon tetrachloride is a liquid much more dense than water. 11. Bromine is far less abundant than chlorine or fluorine. 12. Steel is far less brittle than cast iron.

Ex. 10. Translate the sentences into Russian, paying attention to modal verbs.

1. The text that you must have read describes the properties of halogens. 2. This student can't have started the reaction before learning the properties of the substances. 3. The author may have supposed that this description would help to understand his idea better. 4. The teacher may have spoken about such reactions, I don't remember. 5. Mendeleyev could have presented his periodic system himself, but he was ill. 6. You ought to have been more attentive working in the laboratory. 7. The scientists of our faculty may have discovered some new properties of electrodes, now they are writing an article on this problem. 8. Everyone must have noticed a blue-violet vapour when iodine was being warmed. 9. The reaction may not proceed to completion without heating. 10. The laboratory assistant can't have done all the work alone. 11. Our friends haven't come yet, they must be still working in their laboratory. 12. You should have paid more attention to a theoretical course before starting your practice. 13. The reaction must have occurred, the colour of the reagents has changed. 14. Chemistry couldn't have reached the present level of development without the atomic theory. 15. The discovery of the periodic law must have been the greatest discovery in the nineteenth-century chemistry. 16. The researchers would have tested their results by experiment, but they had no all the necessary apparatus. 17. Newton may have thought that light was a stream of particles. 18. Suggestions were made as to what may have occurred during the reaction.

Ex. 11. Translate the sentences into English.

1. Галогены — это элементы VII группы. 2. Все галогены состоят из двухатомных молекул. 3. Самый обычный из галогенов, хлор, — это зеленовато-желтый газ. 4. Хлор был впервые получен шведским химиком Шееле в 1774 году. 5. Сейчас хлор получают в больших масштабах электролизом раствора хлорида натрия. 6. Бром встречается в малых количествах в виде соединений в морской воде и природных отложениях солей. 9. Йод также может встречаться в очень малых количествах в морской воде.

Ex. 12. Make up questions to the italicized parts of the sentences.

1. *Halogens* may have interested *chemists* since *early times* (3). 2. *Iodine* is an almost black crystalline *solid* with a *slightly metallic* lustre (3). 3. *The solutions* of iodine in water containing potassium iodide and *in alcohol* are *brown* (3).

Ex. 13. Answer the following questions:

1. What elements are called halogens? 2. Why may the halogens have interested chemists? 3. What is the most common of the halogens? 4. When was chlorine obtained? 5. In what way is chlorine obtained now? 6. What kind of element is bromine? 7. Where does bromine occur and in what form? 8. In what way is iodine made commercially? 9. What kind of element is iodine?

Section II

Упр. 1. Прочтите заглавие текста 9 В. Скажите, о чем, по вашему мнению, в нем пойдет речь? Что вы знаете об этом элементе?

Упр. 2. Назовите значения следующих интернациональных слов:

halogen, inert, react, reaction, reactive, reactivity, gas, electronegativity, asbestos, silicate, aluminium, platinum, attack, container, protect, electrolysis, electron, electrode, limit, voltage, extremely

Упр. 3. Определите значения выделенных слов по контексту. Синонимы в скобках помогут вам.

1. The symbols for *fluorine* and *copper* are F and Cu. 2. Fluorine forms compounds with all the elements *except* the lighter inert gases. 3. *Hold* (keep) the test-tube in hot water. 4. Even asbestos reacts very *vigorously* (intensively) with fluorine. 5. The substance is called *incandescent* when it is heated so much that it is giving out light. 6. Chemists *expect* (believe, hope) that some new elements will be synthesized. 7. *The oxidizing power* (ability to oxidize) of an electrode can be increased.

Слова к тексту:

attribute to — относить к; **wood** — древесина; **rubber** — каучук, резина; **burst into flame** — загореться; **stream** — поток; **thin** — тонкий; **layer** — слой; **affinity** — сродство; **it took him** — ему потребовалось

Text 9 B

Прочтите текст про себя (контрольное время чтения — 4 минуты).

Fluorine

Fluorine, the lightest of the halogens, is the most reactive of all the elements, and it forms compounds with all the elements except the lighter inert gases. This great reactivity may be attributed to the large value of its electronegativity. Substances such as wood and rubber burst into flame when they are held in a stream of fluorine, and even asbestos (a silicate of magnesium and aluminium) reacts vigorously with it and becomes incandescent. Platinum is attacked only slowly by fluorine. Copper and steel can be used as containers for the gas; they are attacked by it, but become coated with a thin layer of copper fluoride or iron fluoride, which then protects them against further attack.

Because its electronegativity is greater than that of any other element, we cannot expect that fluorine could be prepared by reaction of any other element with a fluoride. It could have been made, however, by electrolysis of fluorides, since the oxidizing power (electron affinity) of an electrode can be increased without limit by increasing the applied voltage. Fluorine was first obtained by the French chemist Henri Moissan (1852–1907) in 1886 by the electrolysis of a solution of KF in liquid HF. The work must

have been extremely difficult, for it took him several years of hard experimenting to obtain free fluorine gas.

Упр. 4. Скажите, узнали ли вы что-нибудь новое из текста 9 В? Если узнали, то что именно?

Упр. 5. Разделите текст на тематические части и озаглавьте каждую часть.

Упр. 6. Скажите, что говорится в тексте:

1) о способности фтора соединяться с другими элементами; 2) о том, чем объясняется высокая реакционная способность фтора; 3) о воздействии фтора на асбест; 4) о том, как фтор был впервые получен.

Упр. 7. Найдите в тексте отрывок, где описываются возможности получения фтора и переведите его на русский язык.

Section III

Ex. 1. Think of the situations when the following expressions may be used:

it takes me (you, him, her, us, them); *it took* me (you, him, her, us, them); *it'll take* me (you, him, her, us, them)

Ex. 2. Translate the following into English, using the expressions from exercise 1:

1. На подготовку к семинару у меня обычно уходит 2–3 часа. 2. Сколько вам потребуется времени, чтобы выполнить эту лабораторную работу? 3. Вчера я потратил 40 минут на выполнение этого упражнения. 4. Сколько тебе потребуется времени, чтобы сходить домой и вернуться обратно? 5. Он живет недалеко, ему надо не более 15 минут, чтобы дойти до факультета. 6. Этот текст трудный. Мне понадобится часа два, чтобы перевести его письменно. 7. Теперь ты не будешь тратить много времени на дорогу в библиотеку, у тебя в доме на первом этаже открывается новая библиотека. 8. У нас сегодня собрание. 9. Обычно я езжу в университет на троллейбусе и на автобусе, у меня на это уходит 50 минут. А сегодня я поехал на метро и на автобусе, и мне понадобилось всего 35 минут. 10. Вчера мне пришлось лечь спать поздно, понадобилось много времени, чтобы подготовиться к семинару.

Ex. 3. Make up sentences or short stories with the following words:

1) most, halogen, chlorine, common, be, greenish-yellow, gas, irritating, odour, sharp, it, Swedish, 1774, make, Sheele, chemist; 2) easily, dark, bromine, be, volatile, reddish-brown, liquid, disagreeable, strong, odour, have, effect, irritating, eyes, throat; 3) almost, solid, iodine, be, black, slightly, lustre, crystalline, metallic; 4) halogen, reactive, it, all, fluorine, light, form, element, compound, except, gas, inert

Ex. 4. Give detailed answers to the following questions:

1. Why are the halogens interesting for chemists? 2. What can you say about chlorine? 3. What kind of substance is bromine? 4. What do you know about iodine? 5. What are the properties of fluorine?

Ex. 5. Discuss the following topics:

1. The Occurrence of the Halogens in Nature.
2. The Preparation of the Halogens.
3. The Properties of the Halogens.
4. Fluorine — the Most Reactive of the Halogens.

DO YOU KNOW THAT...

Salt consists of two poisons. Salt is made up of the metal, sodium, and the gas, chlorine. Both of these are poisons. But when they are chemically combined, you can eat them safely.

Lesson 10

ГРАММАТИКА: Формы и употребление сослагательного наклонения.

Section I

Ex. 1. Pronounce the following words:

a)

c + *e, i, y*	[s]	place, acid, central, presence, city, per cent, except, circle, cinema, century, precipitate, decide, December, face, necessary, peace, pencil, cycle, cyclic, cylinder, receive, process
c	[k]	become, active, compose, occur, direct, combine, compound, electrode, application, react, prospect, collect, nitric, cold, according, effect, can, zinc, consider, picture
ci	[ʃ]	commercial, socialist, coefficient, special, efficiency, especially, dissociate, associate, sufficient, appreciable
	[s]	calcium, glacial, society, specific, specimen, dissociation, association
ch	[tʃ]	such, which, chair, change, children, each, much, rich, March, teach, choose, touch
	[k]	chemist, chemistry, chemical, characteristic, chlorine, chloride, mechanical, technical
tch	[tʃ]	catch, watch, switch
ck	[k]	back, black, clock, hockey, quick, ticket, attack, check, nickel, thick

b) laboratory [lə'bɒrətrɪ], curiosity [ˌkjʊərɪ'ɒsɪtɪ], available [ə'veɪləbl], exhibit [ɪg'zɪbɪt], anhydrous [æn'haɪdrəs], dilute [daɪ'lu:t], equation [ɪ'kweɪʃən], hydroxide [haɪ'drɒksaɪd], residue ['rezɪdju:], approximately [ə'prɒksɪmətlɪ]

Ex. 2. Read the following words and say what Russian words help to understand their meanings:

gram, laboratory, mineral, per cent, characteristic, group, oxide, combination, halide, stable, hydrate, electrode, potential, concentrate, reaction, metallic, volt, spectral, line, analysis, method, extract, zinc, indium, material, collect, mass, cadmium, filter, filtrate, result, neutralize, basic, sulphite

Ex. 3. Pay attention to the following way of word-building:

основа слова + ***-ate*** [eɪt] [ɪt] → **существительное** sulphate, filtrate, precipitate, nitrate, carbonate → [ɪt] **прилагательное** accurate, immediate, appropriate → [eɪt] **глагол** operate, separate, evaporate, precipitate, investigate, correlate, dissociate, formulate
основа слова + ***-y*** → **прилагательное** watery, healthy, ordinary, necessary, spongy
основа слова + ***-able, -ible*** → **прилагательное (со значением возможности)** [eɪbl] able, stable, unstable, enable [ɪbl] possible, sensible [əbl] agreeable, probable, capable, considerable, desirable, available

Ex. 4. Give the initial forms of the following words and find their meaning in a dictionary:

attempted, applications, quantities, exhibits, places, lies, series, extracting, ores, considered, leaving, boiled, analyses, composed, precipitated, halides, supplies, salts, curiosities

Ex. 5. Define the meaning of the italicized words.

1. No commercial applications of indium were *attempted* for many years. 2. Their *attempt* to obtain pure indium was a success. 3. The available *supply* of indium at that time was only one gram. 4. Some compounds of indium were *supplied* for further analysis. 5. $In(OH)_3$ is *precipitated* from an indium salt solution. 6. When KOH was added to an indium salt solution, a *precipitate* of $In(OH)_3$ was formed.

Text 10 A

Indium

Indium was regarded as a laboratory curiosity for many years and no commercial applications were attempted until 1924. It would hardly be possible to think of its application, for the available supply at that time was only one gram, with no immediate prospects of more.

Indium seldom occurs in a mineral in quantities over 0.1 per cent.

Several methods of extracting indium from its ores should have been considered. According to one of them, indium-bearing zinc metal was treated with a quantity of dilute H_2SO_4 which would dissolve almost all the material, leaving a residue of zinc. On this residue there was collected a spongy mass composed of lead, copper, cadmium, tin, arsenic, iron, and indium. Nitric acid was used to dissolve the spongy mass, after which the solution was evaporated with sulphuric acid. Lead sulphate was left behind on the filter. The filtrate was treated with NH_3(aq) to precipitate $In(OH)_3$ and $Fe(OH)_3$ which were dissolved in HCl. The resulting solution was approximately neutralized and boiled with $NaHSO_3$, which precipitated the basic sulphite, $In_2(SO_3)_3 \cdot In(OH)_3 \cdot 5H_2O$. The basic sulphite was dissolved in sulphuric acid and pure $In(OH)_3$ was obtained by the addition of NH_3(aq).

Indium exhibits properties characteristic of the aluminium group.

Indium burns in air with a blue flame to form the sesquioxide, In_2O_3. If it were heated in the presence of halogens or sulphur, direct combination would take place. In each case indium goes to its highest oxidation state. The other halides (InX and InX_2, where X is a halogen) have been prepared, with the possible exceptions of InF and InF_2. Only the halides, InX_3, are stable in the presence of water. There are three tri-fluorides of indium, the hydrates of the compositions $InF_3 \cdot 3H_2O$ and $InF_3 \cdot 9H_2O$ and the anhydrous salt, InF_3. Most indium compounds are soluble in water.

Words and Word-Combinations to Be Memorized

acetic acid, addition, almost, aluminium, analysis, anhydrous, approximately, attempt, available, basic, boil, case, collect, compose, composition, dilute, direct, electrode, equation, evaporate, exception, exhibit, extract, filter, fluoride, halide, hardly, hydroxide, indium, laboratory, lie, mass, material, most, nitric acid, oxidation, per cent, potential, precipitate, prevent, regard, residue, salt, seldom, series, sulphite, soluble, supply, take place, volt

Ex. 6. Give the Russian equivalents for the following:

attempt applications, regard smth. as, hardly, be available, immediate prospects, over 1 per cent, exhibit properties, burn with a blue flame, in the presence of, take place, in each case, oxidation state, with the exception of, be soluble in water, in the electromotive series, an electrode potential, dilute acid, react with the evolution of hydrogen, together, concentrated

acid, acetic acid, according to the equation, to have some effect on smth., to dissolve almost all the material, the resulting solution

Ex. 7. Give the English equivalents for the following:

в течение многих лет, едва ли возможно, в количестве свыше 1 процента, рассмотреть, несколько методов, разбавленная серная кислота, почти все вещество, на фильтре, получающийся раствор, проявлять характерные свойства, гореть на воздухе, прямое соединение, происходить (иметь место), в каждом случае, за исключением чего-то, в присутствии воды, безводная соль, большинство соединений, концентрированная кислота, по уравнению (согласно уравнению), спектральный анализ

Ex. 8. Fill in the blanks with prepositions where necessary.

of, at, in, between, with, from, according to, for

1. ... many years indium was regarded as a laboratory curiosity. 2. There are several methods ... extracting ... indium ... its ores. 3. ... one ... the methods ... obtaining indium, indium-bearing zinc is treated ... dilute H_2SO_4. 4. Indium exhibits properties characteristic ... the aluminium group. 5. Indium burns ... air ... a blue flame. 6. If indium is heated ... the presence ... halogens or sulphur, direct combination takes place. 7. ... each case indium is ... its highest oxidation state. 8. Only the halides, InX_3, are stable ... the presence ... water. 9. Most indium compounds are soluble ... water. 10. Indium lies ... iron and tin ... the electromotive series. 11. Characteristic spectral blue lines ... indium occur ... 451.1mμ and 410.1 mμ.

Ex. 9. a) Mind:

No article is used before nouns denoting some branch of science, the names of chemical elements and the word *school*.

Examples:

1. My younger sister goes **to school**.
2. While **at school** I liked **chemistry** best.
3. **Indium** has an electrode potential of +0.336 volt.

b) Translate the sentences into English.

1. В университете мы изучаем математику, химию, физику, историю и английский язык. 2. Он не любит математику. 3. Она преподает общую химию. 4. В школе мне нравился английский язык. 5. Какие предметы тебе нравились в школе? 6. Какие оценки у тебя были по химии? 7. Фтор — самый интересный из галогенов, так как он самый активный. 8. Моя сестра ходит в школу, больше всего ей нравится русская литература. 9. Индий не встречается в больших количествах. 10. Некоторые элементы, такие, как кальций, железо, магний, играют важную роль в жизни живых организмов. 11. В природе бром встречается реже, чем хлор и фтор.

Ex. 10. Translate the sentences into Russian, paying attention to the subjunctive mood.

1. There would be no life without such elements as carbon, oxygen, hydrogen, etc. 2. It is necessary that the substances be pure. 3. The teacher suggested that the equation of the reaction be written on the blackboard. 4. The solution is diluted lest it be very strong. 5. They would do it once more if they had time. 6. The condition was made that the reaction should proceed slowly. 7. He should have told us about the new time-table. 8. She should have done it yesterday but she didn't know that her results were not accurate. 9. Heating or cooling would affect the state of water, but not its composition. 10. Dry gas would occupy less volume. 11. It would be difficult to find a more abundant element than oxygen. 12. The corrosion would proceed much more rapidly in the presence of oxygen. 13. We would begin the calculation but we have no all the necessary data. 14. You should have known that these are inflammable substances. 15. They should have described the properties of the substances that were obtained. 16. It would be true to say that experiment is the foundation of chemistry. 17. The new apparatus would have given more accurate results. 18. It is essential that water should be turned into vapour. 19. I wish she were right. 20. I should have asked the teacher but I could not come to the seminar. 21. They suggest that the experiment be started at once.

Ex. 11. Translate the sentences into English.

1. Индий встречается в природе в очень незначительных количествах. 2. Свойства индия характерны для элементов III группы. 3. Индий горит на воздухе и образует окисел In_2O_3. 4. Большинство соединений индия растворимы в воде. 5. Разбавленная соляная кислота реагирует с индием с выделением водорода. 6. Уксусная кислота не растворяет индия. 7. Спектральный анализ показывает характерные для индия синие линии.

Ex. 12. Make up questions to the italicized parts of the sentences.

1. *Indium* lies *between iron and tin* in the electromotive series (2). 2. *Two* reactions are possible with *concentrated sulphuric acid* (3). 3. *Several* methods of extracting indium *from its ores* are possible (2).

Ex. 13. Answer the following questions:

1. What is the occurrence of indium in nature? 2. What properties does indium exhibit? 3. What can you say about commercial applications of indium? 4. What kind of oxide does indium form? 5. What compounds of indium and the halogens are known? 6. In what way does indium react with sulphuric acid? 7. What does the spectral analysis show?

Section II

Упр. 1. Прочтите заглавие текста 10 В. Скажите, знаете ли вы что-нибудь по этому вопросу?

Упр. 2. Назовите значения следующих интернациональных слов:

material, medicine, pharmaceutical, thallium, platinum, busmuth, temperature, corrosion, discomfort, patient, dentist, amalgamate, diffuse, uniform, porous, attack, diffuse

Упр. 3. Определите значения выделенных слов по контексту. Синонимы в скобках помогут вам.

1. Sometimes chemists add indium to obtain *desirable* (needed) properties of substances. 2. Indium forms *alloys* (mixtures of metals) with lead, tin, silver, gold, platinum and others. 3. Unique properties of indium *enable* (give the possibility) it to be used in medicine. 4. Indium alloys are very *corrosion-resistant* (unaffected by corrosion). 5. Indium can be deposited on the *article* (thing) coated with zinc or cadmium.

Слова к тексту:

purpose — цель; **jewellery** — ювелирные изделия; **mordant** — вещество, закрепляющее краску; **dyestuff** — краситель; **braze** — паять; **insert** — вставка; **cast** — форма (*для отливки*); **limbs** — конечности; **molten** — расплавленный; **filling** — пломба (*зубная*); **conventional** — обычный; **plate** — покрывать металлом; **bake** — запекать; **chip** — откалываться; **peel** — шелушиться

Text 10 B

Прочтите текст про себя (контрольное время чтения — 6 минут).

Uses of Indium

Indium finds most of its uses as an addition to other materials for the purpose of obtaining more desirable properties.

Indium and its compounds also find uses in jewellery, pharmaceuticals, medicines, mordants for dyestuffs, and also in low-melting-point alloys.

Indium forms alloys with many metals; some of them are lead, thallium, tin, silver, gold, platinum, mercury, bismuth, and sodium. Alloys of Au–In have good brazing characteristics. For example, the alloy of 77.5 per cent Au and 22.5 per cent In has a working temperature of about 500°C. This enables the alloy to be used on metal pieces with glass inserts. Indium alloys are very corrosion-resistant.

Low-melting alloys could also be used in making casts for broken limbs; a form is made around the broken member and the molten alloy poured into it. The alloy would be at a temperature which would cause no discomfort to the patient.

In dental work, indium amalgamated with mercury was frequently used. In fact, this must have been the first commercial use of indium. The resulting fillings were harder, more resistant to corrosion and discoloration than conventional fillings and looked little different.

Indium cannot be plated on ferrous metals directly. However, by first coating the iron or steel with a metal such as zinc, cadmium, or some similar metal which has a higher electrode potential than the iron or steel and indium plate could be deposited successfully. After such a plate is deposited the article is baked at a temperature slightly above the melting point of indium for several hours. The indium and the other non-ferrous metal diffuse into one another, to produce a uniform plate which would not chip or peel and which would be non-porous.

Indium can be plated directly on non-ferrous metals. Generally, the plate is diffused into the base metal by the method mentioned above. Such coatings are more resistant to certain kinds of chemical attack than the base metal and are usually harder.

Упр. 4. Что нового вы узнали из текста 10 В?

Упр. 5. Разделите текст на тематические части и озаглавьте каждую часть.

Упр. 6. Скажите, что говорится в тексте:

1) о сферах применения индия и его соединений; 2) о сплавах индия с другими металлами; 3) о применении индия в медицине.

Упр. 7. Найдите в тексте место, где говорится об особенностях нанесения слоя индия на металлы. Переведите этот отрывок на русский язык.

Section III

Ex. 1. Think of the situations with the following expressions. Mind the difference in the word-order.

Here is the pen. (Вот ручка.) ***Here it is.*** (Вот она.)
Here are the books. (Вот книги.) ***Here they are.*** (Вот они.)

Example:
— Give me your copy-book, please. (Дай мне тетрадь, пожалуйста.)
— Here you are. / Here it is. (Пожалуйста.)

Ex. 2. Translate the following questions or requests and react to them. Use expressions from exercise 1.

1. Дай мне, пожалуйста, твою книгу. 2. Где пробирки? 3. Дайте мне, пожалуйста, ваши словари. 4. Где лаборатория общей химии? 5. Ты не знаешь, где библиотека? 6. Поставь, пожалуйста, лампу на этот стол. 7. Дайте мне посмотреть ваши расчеты. 8. А где результаты последнего анализа? 9. Дай мне, пожалуйста, учебник по истории. 10. Покажи мне, пожалуйста, свой перевод.

Ex. 3. Make up sentences or short stories with the following words:

1) seldom, mineral, indium, occur, 0.1 per cent, quantity; 2) form, compound, indium, various, most, be, they, water, soluble; 3) can, ore, several, indium, extract, method; 4) react, indium, nitric acid, reaction, possible, concentrated, two, be, sulphuric acid

Ex. 4. Give detailed answers to the following questions:

1. Why wasn't indium used commercially before 1934? 2. What methods of extracting indium from its ores do you know? 3. What compounds can indium form? 4. In what way does indium react with acids? 5. What are the main uses of indium?

Ex. 5. Discuss the following topics:

1. The Occurrence of Indium.
2. The Properties of Indium.
3. The Uses of Indium.

DO YOU KNOW THAT...

In 1863 Reich and Richter, in an effort to trace thallium in zinc blende observed two new blue lines in the spectrum. The zinc blende had been roasted to remove most of the arsenic and sulphur. The residue had been dissolved with hydrochloric acid and evaporated to dryness. This residue of crude zinc chloride was submitted to a spectrum analysis. They discovered the new element, indium, so named from its characteristic blue lines.

Lesson 11

ГРАММАТИКА: Употребление и перевод глаголов *may, might, could, ought* в сослагательном наклонении.

Section I

Ex. 1. Pronounce the following words.

a)	ph	[f]	physical, physics, phase, phenomenon, sphere, phosphorus, phosphorescent, sulphur, amorphous
	th	[θ]	thank, theatre, theory, thing, think, three, third, thirteen, thirty, Thursday, thousand, method, hypothesis, lithium, mathematics, growth, length, synthesis, thorough, through
		[ð]	the, than, other, with, that, this, then, these, those, they, their, them, there, thus, rather, further, either, though, nevertheless

x	[ks]	axis, box, mix, mixture, exception, next, excess, excercise, except, approximately, experiment, explain, oxygen, expression, extract, extremely, oxide
	[gz]	examine, examination, example, existence, exhibit, exact, auxiliary
kn	[n]	know, knowledge
wr	[r]	write, writer, wrong

b) peculiar [pɪ'kju:lɪə], category ['kætəgərɪ], intrigue [ɪn'tri:g], phosphorescent [ˌfɒsfə'resnt], elusive [ɪ'lʊsɪv], magic ['mædʒɪk], urine ['jʊərɪn], nevertheless [ˌnevəðə'les], elaborate [ɪ'læbərɪt], waxy ['wæksɪ], abandon [ə'bændən], fascinating ['fæsɪneɪtɪŋ]

Ex. 2. Read the following words and say what Russian words help to understand their meaning:

phosphorus, interesting, special, category, reason, intrigue, substance, phosphorescent, history, alchemist, elusive, idea, magic, human, series, distil, detail, preparation, secret, formula, method, isolate, limit, modern, intensely, extremely

Ex. 3. Pay attention to the following way of word-building:

основа слова + *-ous* [əs] → прилагательное	
various, religious, curious, poisonous, obvious, analogous, amorphous, ferrous, anhydrous, famous	
основа слова + *-(i)an* (принадлежность к чему-либо)	прилагательное: human, proletarian, republican существительное: historian, academician, technician, physician, musician

Ex. 4. Arrange the words in the alphabetic order, give their initial forms and find their meanings in a dictionary. Do it as quickly as you can.

glowing, rarely, searching, stones, carried (on), thrilled, leaked (out), bones, abandoned, equipment, fascinating, allowed, causes, burns, heals, handles, forcepts, fumes

Ex. 5. Define the meaning of the italicized words.

1. Brand *carried* on a series of elaborate experiments. 2. We went away late, only when we *carried out* all the experiments. 3. It is difficult to *carry* this bag, it is very heavy. 4. The container started *leaking*. 5. The news soon *leaked out*. 6. Phosphorus should never be allowed to touch the *skin*. 7. We usually peel the *skin* of the potatoes before boiling. 8. Tiger's *skin* is very beautiful.

Text 11 A

Fascinating Phosphorus

Phosphorus is one of the most interesting of all the elements. Its peculiar property of glowing in the dark places it in a special and rare category. For some unexplained reason, man has always been intrigued by any substance with phosphorescent properties.

The history of phosphorus is no less interesting than the element itself. It was first prepared in 1669 by a German alchemist Hennig Brand, who like every other alchemist of his day, was searching for the elusive philosopher's stone. We can never tell you what gave him the idea that his magic stone could be found in human urine, but, nevertheless, he carried on a series of elaborate experiments with urine. After much experimentation he could obtain a yellowish waxy substance by distilling a residue from the urine. We can imagine how thrilled he must have been when he noticed that the strange substance glowed in the dark.

Brand kept the details of the preparation of this strange substance secret, but the news soon leaked out. He then sold his formula to other chemists, who also made the element in secret. The method of isolating phosphorus was made known to the world in general only in 1737. It was soon discovered that the element could be obtained from bones, and the unpleasant method of obtaining it from urine could be abandoned. It is truly remarkable that Brand could prepare phosphorus with very limited equipment and knowledge then available. Even today with all of our modern equipment, phosphorus is not isolated with ease.

Phosphorus may be fascinating, but is also intensely poisonous. It should never be allowed to touch the skin, as it causes painful burns which are extremely difficult to heal. We must always handle it with forceps and keep it under water when it is not in use.

Phosphorus has a garlic-like colour. Its fumes are poisonous too.

Words and Word-Combinations to Be Memorized

allow, category, detail, distil, in general, handle, isolate, itself, limit, method, notice, phosphorus, poisonous, preparation, rare, reason, for this (that) reason, residue, strange, urine, wax

Ex. 6. Give the Russian equivalents for the following:

be one of the most interesting, a peculiar property, a special category, for some reason, phosphorescent properties, nevertheless, carry on experiments, a series of experiments, keep the details of the preparation secret, in secret, make the method known to the world in general, obtain some element, abandon some method, very limited equipment, available knowledge, isolate an element with ease, be poisonous, cause pain, be extremely difficult, handle phosphorus, keep under water

Ex. 7. Give the English equivalents for the following:

редкая категория, быть интересным, в темноте, по какой-то причине, сам элемент, как всякий другой алхимик, искать что-либо, навести на мысль, проводить ряд экспериментов, желтоватое вещество, заметить какое-то свойство, держать в секрете, метод выделения фосфора, вообще, только в 1737 году, получать элемент из, имеющееся оборудование, даже сегодня, современное оборудование, быть ядовитым, обращаться с, держать (хранить) под водой

Ex. 8. Fill in the blanks with prepositions where necessary.

in, under, at, with, of, on, by, for

1. Phosphorus is one ... the most interesting ... all the elements. 2. Phosphorus has a peculiar property ... glowing ... the dark. 3. ... some unexplained reason man has always been interested ... any substance ... phosphorescent properties. 4. Phosphorus was first prepared ... 1669 ... a German alchemist Brand. 5. Brand carried ... a series ... experiments to obtain phosphorus. 6. Brand kept the details ... the preparation ... phosphorus ... secret. 7. The method ... isolating phosphorus was made known ... the world ... general only ... 1737. 8. Brand prepared phosphorus ... very limited equipment and knowledge. 9. ... present phosphorus is not isolated ... ease. 10. Phosphorus should be kept ... water when it is not ... use.

Ex. 9. Translate the sentences into Russian paying attention to the word *one/ones*.

1. Hydrogen atom contains only one electron and one proton. 2. Red phosphorus is more stable than the white one. 3. An element is a substance which consists of only one kind of atoms. 4. The salts formed by hydrochloric acid are called chlorides, the ones formed by sulphuric acid are called sulphides. 5. Chlorine exists in two isotopic forms: the one has the atomic weight of 35 and the other — of 37. 6. Phosphorus is one of the elements of Group V. 7. Reactions of dilute acids and the concentrated ones are not alike. 8. Phosphorus exists in several allotropic modifications, yellow and red are the most common ones. 9. The chemical properties of ozone are similar to those of oxygen, but one must point out that ozone is more chemically active. 10. Phosphorus is readily dissolved in carbon disulphide, one part of it will dissolve nine parts of phosphorus. 11. This modern apparatus gives more accurate results than the old one and it is much easier to handle.

Ex. 10. Translate the sentences into Russian, paying attention to the verbs *may, might, could, ought*.

1. Phosphorus may be fascinating, but it is also intensely poisonous. 2.Whenever you may work with phosphorus, remember, it must not be handled with bare hands. 3. The instruction was quite clear so that the students might perform the analysis themselves. 4. Such unexpected results

might be accounted for by the fact that the substance was not very pure. 5. However slow the reaction may proceed, it gives a good yield. 6. They suppose they could finish their series of experiments by Friday. 7. The calculations ought to be done after each series of measurements. 8. Important as this question may be, we have no time to discuss it now. 9. In order that the glassware might be used, it should be thoroughly washed. 10. The author gives a very detailed description of the properties of each element lest anything may be missed. 11. It is quite clear that the reaction could go to completion after some heating. 12. The methods of preparation of phosphorus could have been mentioned together with the description of properties. 13. The experiment ought to be repeated several times, so that you could get some results to compare. 14. In the middle of the 18th century it was discovered that phosphorus could be obtained from bones. 15. Oxygen and hydrogen could be obtained by the electrolysis of water. 16. The question how many elements are essential to life couldn't be answered with certainty. 17. Some generalizations ought to be made about the role of various elements. 18. The scheme of the process is given in addition to the photograph so that the reader may understand it better. 19. Such research might tell us about the carbon chemistry. 20.These observations reveal chemical mechanisms that could only have been uncovered by studies of reactions at high energies.

Ex. 11. Translate the sentences into English.

1. Фосфор обладает интересным свойством светиться в темноте. 2. История фосфора не менее интересна, чем сам элемент. 3. Фосфор был впервые приготовлен в 1669 году, но метод его приготовления стал известен миру только в 1737 году. 4. Как и все алхимики, свой метод приготовления фосфора Бранд держал в секрете. 5. Необходимо помнить, что фосфор очень ядовит. 6. Известны несколько аллотропных форм фосфора. 7. Фосфор нелегко выделять даже при современном оборудовании. 8. Одна из форм фосфора — это желтоватое воскообразное вещество, такой фосфор называют желтым или белым.

Ex. 12. Make up questions to the italicized parts of the sentences.

1. *For some unexplained reason*, man has always been intrigued by any *substance* with *phosphorescent* properties (3). 2. It was *soon* discovered that *phosphorus* could be obtained *from bones* (3). 3. Its peculiar *property of glowing in the dark* places phosphorus *in a special and rare category* (3).

Ex. 13. Answer the following questions:

1. What is the most interesting property of phosphorus? 2. When was phosphorus first prepared? 3. What kind of substance is it? 4. What methods were used to prepare phosphorus? 5. Why is it necessary to be careful working with phosphorus? 6. How must phosphorus be kept when it is not in use?

Section II

Упр. 1. Прочтите заглавие текста 11 B. Скажите, чему будет посвящен этот текст? Что вы об этом знаете?

Упр. 2. Назовите значения следующих интернациональных слов:

modification, allotropic, violent, regular, amorphous, action, catalyze, separate, crystallization, distillation, condense, disulphide, spontaneously

Упр. 3. Определите значения выделенных слов по контексту. Синонимы в скобках помогут вам.

1. *As to* the properties of phosphorus, they are very interesting. 2. Phosphorus *ignites* (takes fire) in the air at the temperature of 30 *degrees*. 3. Substances that easily take fire are called *inflammable* substances. 4. *A pressure* of 760 mm Hg is called normal atmospheric *pressure*. 5. Phosphorus combines *readily* (easily) with oxygen. 6. Some reactions can be catalyzed by *traces* (very small amounts) of substances. 7. *Opinions* (points of view) concerning this problem differ. 8. *Reduction* is a process when a pure substance is obtained from an oxide. 9. It is difficult to *realize* (understand) that yellow and red phosphorus are the same element. 10. A very finely divided substance is a *powder*. 11. Red phosphorus can be prepared by heating yellow phosphorus in the *absence* of air (without air).

Слова к тексту:

trace — прослеживать; **partially** — частично; **careful** — осторожный; **drum** — барабан; **vaporize** — испаряться; **pretty** — хорошенький, прелестный; **dangerous** — опасный; **dispose of** — избавляться от

Text 11 B

Прочтите текст про себя (контрольное время чтения — 5 минут).

Modifications of Phosphorus

Yellow Phosphorus. Phosphorus may occur in three allotropic forms: yellow, violet, and black. However, the two most common forms are yellow and red. There can be traced a difference of opinion as to whether the red form is a separate allotropic modification. One of the latest theories is that red phosphorus might be phosphorus only partially changed from the yellow to the violet form.

The phosphorus obtained by the reduction of phosphorus is always the yellow variety. This is "regular" phosphorus and the other allotropic forms can be prepared from it.

Phosphorus is able to combine readily with oxygen and ignite in the air at 30 degrees.

Phosphorus is very soluble in carbon disulphide.

Be very careful with the phosphorus solution, as it is highly inflammable. Dispose of it immediately after experimenting either by burning it or washing it down the drum with large quantities of water.

Red phosphorus is so unlike yellow phosphorus, that it is difficult to realize that both forms are the same element. The red type is an amorphous powder. It will not ignite spontaneously. It will not dissolve in carbon disulphide. It will not glow in the dark. It has no odour and is not poisonous. It ignites only when it is heated to about 240 degrees.

Red phosphorus can be prepared by heating yellow phosphorus in the absence of air. The action may be catalyzed by a trace of iodine.

Violet phosphorus can be prepared by dissolving phosphorus in molten lead and then allowing it to separate by crystallization.

Black phosphorus could be made by subjecting yellow or red phosphorus to 4,000 atmospheres of pressure at a high temperature.

The yellow phosphorus can be prepared from any other form by distillation. When they are heated strongly enough, all forms of phosphorus vaporize and this vapour always condenses to form the yellow variety.

Remember — phosphorus is like a pretty girl: always *interesting*, but sometimes *dangerous*!

Упр. 4. Что нового вам удалось узнать из текста 11 В по сравнению с текстом 11 А?

Упр. 5. Текст имеет подзаголовки. Выделите основную мысль каждого отрывка, имеющего подзаголовок.

Упр. 6. Скажите, что говорится в тексте:

1) об аллотропных формах фосфора; 2) о фосфоре, полученном методом восстановления; 3) о том, что представляет собой красный фосфор; 4) о способе получения черного фосфора; 5) о способе получения желтого фосфора.

Упр. 7. Найдите в тексте предложения, касающиеся соблюдения осторожности при работе с фосфором и переведите их на русский язык.

Section III

Ex. 1. Think of the situations when the polite ways of expressing request may be used.

I (you, he, she, we, they) ***should*** (***would***) ***like to***; ***I'd like to***; ***Could*** you...

Example: I should like to read this book, I know it is very interesting, could you give it to me for some days?

Ex. 2. Translate the sentences into English, using expressions from exercise 1.

1. Не могли бы вы сказать мне, какие из этих статей стоит читать? 2. Ты не мог бы помочь мне перевести это предложение? 3. Я хотел бы научиться читать химическую литературу без словаря. 4. Не могли бы

вы показать мне, где лаборатория аналитической химии? 5. Я хотел бы работать в этой лаборатории. 6. Ему хотелось бы прослушать весь курс лекций профессора N, но ему надо уезжать. 7. Она хотела бы заниматься в нашей группе. 8. Нам хотелось бы закончить работу поскорее. 9. Ты не мог бы пойти со мной? 10. Не могли бы вы встретиться с вашим другом и попросить у него последний номер журнала?

Ex. 3. Make up sentences or short stories with the following words:

1) be, interesting, phosphorus, always, scientist, it, peculiar, phosphorescence, because, possess, property; 2) phosphorus, substance, be, poisonous, dangerous, careful, handle, must, we; 3) allotropic, three, occur, form, phosphorus, red, yellow, common, be; 4) belong, substance, phosphorus, category, inflammable

Ex. 4. Give detailed answers to the following questions:

1. Why did phosphorus interest alchemists? 2. What is the history of phosphorus? 3. What is to be known when you work with phosphorus? 4. Describe modifications of phosphorus. 5. What are the properties of phosphorus?

Ex. 5. Discuss the following topics:

1. The Discovery of Phosphorus.
2. The Phosphorus is a Dangerous Substance.
3. The Modifications of Phosphorus.

DO YOU KNOW THAT...

One of the first known applications of phosphorus was the production of matches. At present phosphorus plays its most important part in agriculture. Phosphatic fertilizers are widely used in modern agriculture. The presence of phosphates in the soil is necessary for plant growth.

Lesson 12

ГРАММАТИКА: Повторение темы «Сказуемое».

Section I

Ex. 1. Pronounce the following words:

Помните, что в многосложных словах ударение часто падает на 3-й слог от конца слова, а ударные гласные читаются кратко, даже в открытом слоге.

a) element ['elɪmənt], significance [sɪg'nɪfɪkəns], different ['dɪf(ə)rənt], physical ['fɪzɪkəl], molecular [mə'lekjulə], evidence ['evɪdəns], excercise ['eksəsaɪz], definite ['defɪnɪt], experiment [ɪks'perɪmənt], necessary ['nesəsərɪ]

b) symbol, atomic, case, simple, change, exhibit, state, rubber, oxygen, show, three, only, pair, inert, avoid, written, also, catch, fire, while, since, way, how, thus, cause, news, world, truly, allow, place, cold, blue, line, pure

c) introduce [ˌɪntrəˈdjuːs], acquire [əˈkwaɪə], quantitative [ˈkwɒntɪtətɪv], either [ˈaɪðə], neither [ˈnaɪðə], allotropy [əˈlɒtrəpɪ], rather [ˈrɑːðə]

Ex. 2. Read the following words and say what Russian words help to understand their meaning:

symbol, publish, extraction, Latin, allotropy, molecular, metallic, associate, pair, inert, confusion, temperature, stable, combine, atom, element, modern

Ex. 3. Pay attention to the following way of word-building:

pre- + основа слова — придает значение «до», «перед», «заранее» prehistoric, prewar, pre-establish, premature, predetermine
post- + основа слова — придает значение «после» post-war, postposition, postgraduate
(приставка) + основа + основа + (суффикс) airplane, seawater, electromotive, electronegativity, shorthand, sidestep, sightseeing, old-time, manmade, lifetime, dielectropositive

Ex. 4. Find the meaning of the following words in a dictionary. If there is no word in your dictionary, find its parts and derive the meaning yourself.

old-fashioned, sidestep, sightsee, furthermore, water-like, therefrom, up-to-date, electropositive, electrostatic, water-proof, oxygen-rich

Ex. 5. Define what part of speech the italicized words belong to.

1. On *account* of their inactivity inert gases are often referred to as noble gases. 2. Some chemical phenomena are not easily *accounted* for. 3. Symbols began as a simple shorthand for the *names* of the *elements*. 4. Polonium was *named* in honour of Poland, the birthcountry of Marie Sklodowska-Curie. 5. At temperature below 0°C, water turns *solid*. 6. Some *solids* practically do not dissolve.

Text 12 A

Chemical Symbols for Elements

The Swedish chemist Berzelius (1779–1848) introduced the modern symbols for the elements when he published a list of "atomic weights" in 1818. Those elements which, on account of their ease of extraction from their ores had been known from prehistoric times, were given symbols derived from their Latin names.

The symbols began as a simple shorthand for referring to the names of the elements, but rapidly acquired a quantitative significance. Pb began meaning "some lead", but it rapidly changed and came to mean either "one atom of lead" or "one gram atomic weight of lead", i. e. 207 g of lead.

Some elements can exhibit allotropy; that is to say, they can exist in two different forms in the same physical state. Taking examples from among gaseous elements, ozone and molecular oxygen both contain only oxygen atoms, yet, the reactions of ozone are completely different from those of oxygen. It will immediately oxidize rubber and metallic silver, whereas oxygen will do neither. Evidence from gas-volume determinations shows that three atoms of oxygen are associated in ozone, whereas there are only two atoms in molecular oxygen. The atoms of all common gaseous elements exist in pairs except the inert gases. To avoid confusion, molecular gases are written O_2, N_2, Cl_2 and ozone O_3.

Some elements also exhibit allotropy; for example, white phosphorus catches fire in air at room temperature while red phosphorus is stable in air at 240°C. But since there is no way of discovering how many atoms are combined together in any solid, the question is sidestepped, and all solid elements including allotropes are given symbols; thus, both white and red phosphorus are P rather than Px.

Words and Word-Combinations to Be Memorized

on account of, associate, avoid, come + инф., completely, confusion, gaseous, either... or..., except, exist, extraction, include, introduce, list, molecular, neither, quantitative, rapidly, rather than, refer to, rubber, since, solid, stable, symbol, volume, yet

Ex. 6. Give the Russian equivalents for the following:

introduce smth., a list of "atomic weights", on account of, refer to the names of the elements, acquire a quantitative significance, either... or..., exhibit allotropy, that is to say, exist in different forms, in the same physical state, take an example, from among gaseous elements, yet, be completely different, whereas, exist in pairs, avoid confusion, for example, catch fire in air, there is no way of, both ... and..., rather than

Ex. 7. Give the English equivalents for the following:

химический символ, шведский химик, из-за (на основании), с доисторических времен, быстро изменяться, либо... либо..., проявлять (какое-либо свойство), в одинаковом состоянии, привести пример, оба, как... так и..., однако, тогда как, например, воспламеняться на воздухе, при комнатной температуре, сколько, таким образом, а не...

Ex. 8. Fill in the blanks with prepositions where necessary.

in, at, of, except, from, for, on account of

1. Berzelius introduced the modern symbols ... the elements ... 1818. 2. Some elements had been known ... prehistoric times ... their ease ...

extraction. 3. The symbols ... these elements were derived ... their Latin names. 4. There are elements which can exist ... two different forms ... the same physical state. 5. Reactions ... ozone are completely different ... those ... oxygen. 6. White phosphorus catches fire ... air ... room temperature. 7. The atoms ... all common gaseous elements exist ... pairs ... the inert gases.

Ex. 9. Supply the definite or indefinite article.

1. Mendeleyev is ... famous Russian chemist. 2. Mendeleyev is ... founder of the Periodic Law. 3. Professor N is ... author of a great number of papers and books. 4. Swedish chemist Berzelius was ... great discoverer. 5. Do you know who ... discoverer of the atomic theory was? 6. Niels Bohr was ... Danish physicist. 7. Chemistry is ... branch of knowledge. 8. Section II is concerned with ... nature of radioactivity. 9. Dr. N discovered ... new law. 10. Faraday was ... well-known English physicist.

Ex. 10. Translate the sentences into Russian, paying attention to the predicates.

1. Chemistry concerns the compositions of matter and their transformations. 2. A great number of Russian scientists, among them Mendeleyev, Lomonosov, Butlerov et al., could be mentioned as contributors to the world science. 3. There are several fields of chemistry in which Russian scientists have achieved significant progress. 4. The Periodic Law laid the foundation for the modern development of chemistry. 5. In the molten state metals are able to interact with one another. 6. Alloys which contain only two metals are referred to as bimetallic. 7. Science has become an important part of the modern world. 8. Chemists are needed almost in every field of life. 9. The theories and laws of chemistry are no less exact as those of physics. 10. Silicon, the fourteenth element in the periodic table might be called a congener of carbon, in Group IV. 11. Attempts to arrange the elements in a definite order were followed by a great discovery, the discovery of the Periodic Law. 12. The periodic table may be interpreted in terms of electronic structure of atoms. 13. Radioactivity was discovered by Henry Becquerel in 1896. 14. The change of the program of experimentation could have given more accurate results. 15. Before definite chemical evidence for the compound nature of a substance was obtained, the substance had been considered an element. 16. In 1903 scientists recognized that radioactivity involves the spontaneous transmutation of elements. 17. Here we are going to give a detailed account of this phenomenon. 18. Heating was to have an important influence on the rate of the reaction. 19. Two points should have been determined: the composition of the sample and the relative weights of its constituent parts. 20. The result of the comparison may be completely the opposite. 21. The next step was to arrange the data in a table. 22. At any given temperature a molecule of a light gas such as helium or hydrogen will have the same average kinetic energy. 23. Chemists must have known a great number of

reactions that can proceed without catalysts. 24. Few chemical reactions involve just a single elementary process. 25. We have prevented the formation of by-products. 26. New methods of investigation are being developed, they are much more effective than the older ones.

Ex. 11. Translate the sentences into English.

1. В 1818 году Берцелиус опубликовал список «атомных весов». 2. Берцелиус ввел современные символы для химических элементов. 3. Некоторые элементы могут существовать в двух различных формах в одном и том же физическом состоянии. 4. И озон, и молекулярный кислород содержат только атомы кислорода. 5. Реакции озона совершенно отличны от реакций кислорода. 6. У озона — три атома кислорода, а у молекулярного кислорода — два. 7. Чтобы избежать путаницы, молекулы газа записываются как O_2, N_2 и т. д. 8. Красный фосфор стабилен на воздухе при температуре 240°С. 9. Белый фосфор, например, воспламеняется на воздухе при комнатной температуре.

Ex. 12. Make up questions to the italicized parts of the sentences.

1. *The symbols* began as *a simple shorthand* for referring to *the names* of the elements (3). 2. Ozone will *immediately oxidize* metallic *silver* (3). 3. There is no way of discovering *how many atoms* are combined together in *any solid* (2).

Ex. 13. Answer the following questions:

1. What were the symbols introduced for? 2. Who introduced the symbols for chemical elements and when did he do it? 3. What significance did symbols acquire? 4. What is the difference in writing allotropic modifications of elements?

Section II

Упр. 1. Прочтите заглавие текста 12В. Скажите, чем, по вашему мнению, он будет отличаться от текста 12А.

Упр. 2. Назовите значения следующих интернациональных слов:

act, constant, composition, formula, experimentally, empirical, inorganic, crystalline, equivalent, sum, proportion, real, alternatively

Упр. 3. Определите значения выделенных слов по контексту. Синонимы в скобках помогут вам.

1. An empirical formula should be written with *brackets* $(HgO)_x$. 2. Mendeleyev *assumed* (supposed) the existence of yet undiscovered elements. 3. *Originally* (at first) oxygen was called "inflammable air". 4. The symbol for *mercury* is Hg. 5. The law of constant composition was known, *therefore* (that is why) it was possible to use a formula for a compound. 6. The formula for *ammonia* is NH_3. 7. A molecule of a

compound *is defined* (is described) as the smallest part of a compound that can exist as a free and separate substance.

Слова к тексту:

the very — сам по себе; **equal** — равный; **determine** — определять; **relative** — относительный; **strictly** — строго; **it makes no claim** — не претендует; **perfectly** — совершенно; **entity** — нечто реально существующее

Text 12 B

Прочтите текст про себя (контрольное время чтения — 4 минуты).

Chemical Symbols for Representing Compounds

It is a short step from using a symbol for an element to using a formula for a compound. However, it is often forgotten that the very act of writing the formula for a compound assumes the law of constant composition. HgO originally meant "some of a compound containing equal numbers of mercury and oxygen atoms". A formula used in this way is referred to as an empirical formula, for it contains only the experimantally determined ratio of the relative numbers of atoms of different elements in the compound, but makes no statement about how many atoms there are in one molecule. An empirical formula should be written with brackets $(HgO)_x$ to show that it makes no claim to represent one molecule of the substance; but for inorganic solids where there is seldom a method of determining x, the brackets are never used.

A molecule of a compound is defined as the smallest part of a compound that can exist as a free and separate substance. For crystalline solids in which one atom is surrounded by several equivalent neighbours, the word "molecule" has no well-defined meaning. Thus, the formula HgO refers to a gram-molecular weight of mercuric oxide, whereas the gram-molecular weight is the sum of gram-atomic weights of the elements in the proportions in which they occur in the compound. For example, zinc has a gram-atomic weight of 65 g and chlorine a gram atomic weight of 35.5 g, so the gram-molecular weight of zinc chloride ($ZnCl_2$) is 135 g.

For gases, the molecule is a perfectly real entity, and the molecular weight of any volatile substance defined as

$$\frac{\text{weight of 1 molecule}}{\text{weight of } {}^{1}/_{12} \text{ atom of carbon 12}}$$

can be measured experimentally. Therefore the formula NH_3 can either refer to one molecule of ammonia, containing one atom of nitrogen, and three atoms of hydrogen, or, alternatively, to one gram-molecular weight of ammonia.

Though the terms "gram-molecular weight" and "gram-atomic weight" are no longer used by chemists, it is interesting to know how the idea

developed. At present, the term "mole" (*mol*) is usually used to name the quantity of a substance.

Упр. 4. Оправдались ли ваши предположения насчет отличия по содержанию текста 12 В от текста 12 А?

Упр. 5. Разделите текст на тематические части и озаглавьте их.

Упр. 6. Скажите, что говорится в тексте:

1) о том, что необходимо было знать, чтобы написать формулу соединения символами; 2) о значении эмпирической формулы; 3) об употреблении скобок при написании эмпирической формулы; 4) как определяется молекулярный вес летучих веществ; 5) что обозначает формула аммиака.

Упр. 7. Найдите в тексте отрывок, где дается определение молекулы и описываются особенности употребления формул для обозначения твердых веществ. Переведите этот отрывок на русский язык.

Section III

Ex. 1. Check up if you remember the ways of expressing time.

a)

2.00	It is two (o'clock).
5.10	It is ten minutes past (after) five. It's ten past five. It's five-ten.
4.15	It's a quarter past (after) four. It's fifteen minutes past (after) four. It's four-fifteen.
2.30	It's half past two. It's two thirty.
7.45	It's a quarter to eight. It's seven forty-five.
2.55	It's five (minutes) to three. It's two fifty-five.

b)

a. m.	*до полудня*
p. m.	*после полудня*

c)

to be fast to be wrong to be slow	*спешить* *идти неправильно* *отставать*	(о часах)

Ex. 2. Answer the following questions, using expressions from exercise 1:

1. What time is it now? 2. When do your classes usually begin? 3. When did the lecture begin? 4. I believe my watch is fast, what time is it by your watch? 5. At what time shall we meet? 6. At what time are your classes over? 7. When do you get up? 8. When will you be free? 9. When will you come to the laboratory?

Ex. 3. Make up sentences or short stories with the following words:

1) introduce, they, symbols, Swedish, begin, shorthand, chemist, simple, Berzelius, element, name; 2) phenomenon, allotropy, such, be, when, can, form, element, exist, different, the same, state, physical; 3) act, formula, law, the very, write, assume, composition, constant; 4) gram, weight, molecular, be, element, seem, atomic

Ex. 4. Give detailed answers to the following questions:

1. In what way were the modern symbols for the elements introduced? 2. What is the meaning of a chemical symbol for an element? 3. In what way do we usually write formulae for compounds? 4. What law is the basis for writing the formula of a compound? 5. What is an atom? 6. What is a molecule?

Ex. 5. Discuss the following topics:

1. The History of the Introduction of Symbols.
2. Symbols for Representing Elements.
3. Symbols for Representing Compounds.

DO YOU KNOW THAT...

Berzelius published his first paper on the new nomenclature in 1813. A year later, he published his second article in which he formulated the rules for writing formulae. The number of atoms was marked by a figure at the upper end of the symbol. If a compound contained two atoms of a particular element, he suggested that the sign should be written in bold type. He marked an oxygen atom in oxides by a point or a comma. Thus, the formula for water was $H^{\cdot}$ instead of H_2O. New symbols for chemical elements were soon accepted by scientists, they proved very convenient, but as to formulae, they were accepted only in the middle of the 19th century.

Part Two

THE SUBJECT

Lesson 13

ГРАММАТИКА: Подлежащее. Существительное в функции подлежащего. Местоимение в функции подлежащего.

Section I

Ex. 1. Practise your pronunciation.

a) period ['pɪərɪəd], ancient ['eɪnʃənt], civilization [ˌsɪvɪlaɪ'zeɪʃn], China ['tʃaɪnə], India ['ɪndjə], Greece [gri:s], Egypt ['i:dʒɪpt], quintessence [kwɪn'tesns], elixir [ɪ'lɪksə], technique [tek'ni:k], iatrochemist [aɪ'ætrəʊ'kemɪst], pursuit [pə'sju:t], phlogiston [flɒ'dʒɪstən], subsequent ['sʌbsɪkwənt], qualitative ['kwɒlɪtətɪv], quantitative ['kwɒntɪtətɪv], identify [aɪ'dentɪfaɪ], urea ['jʊərɪə]

b) there↘are, in◡the↘history, a◡'theory◡of↘numbers, could◡be◡↘changed, 'one◡of◡↘which, and◡the◡↘answer, 'this◡is◡the↘date, ↘proved◡that, the◡dis'covery◡of↘particles

c) There are 'five 'periods | in the 'history of↘chemistry.

Ex. 2. Pay attention to the structure of the following words, translate them into Russian:

a) collective, elusive, native, quantitative, qualitative, imperative

b) afternoon, anything, football, nevertheless, iatrochemist, meanwhile, three-dimentional, withstand, quintessence

c) technique, unique

Ex. 3. Define the meanings of the word *matter* in the following sentences:

1. During the phlogiston period men postulated a hypothetical *matter*. 2. Biology is the science of the physical life of living *matter*. 3. What is the *matter* with you? 4. We haven't discussed this *matter* yet. 5. No *matter* what method of preparation was used, the substance should be pure. 6. It is a

matter of common knowledge that *matter* can be neither destroyed nor created. 7. It is just *the matter* of time when the problem will be solved. 8. As a *matter* of fact the properties were quite different from those postulated.

Ex. 4. Find the predicate and the subject in the following sentences:

1. The ancient period in the history of chemistry comprising the older civilizations developed practical arts and a philosophical approach to the study of matter. 2. The principal goals of an alchemical period were an elixir of life and the philosopher's stone. 3. By the philosopher's stone alchemists wanted to change base metals into gold. 4. This is the date when modern chemistry begins. 5. Organic chemistry was not understood until 1828. 6. Friederich Wöhler proved that the vital force was not needed for the production of compounds. 7. The periodic law withstood the onslaught of the discovery of the subatomic particles.

Text 13 A

The History of Chemistry

There are five periods in the history of chemistry. The ancient period comprising the older civilizations of China, India, Greece, and their contemporaries to 350 A. D. developed practical arts as in Egypt, and a philosophical approach to the study of matter as in Greece, where a theory of numbers, an atomic theory, and a theory of five elements, earth, air, fire, water and the quintessence were proposed.

The alchemical period (350–1500), of which the principal goals were an elixir of life and the philosopher's stone by which base metals could be changed to gold, introduced pure substance and improved techniques.

Iatrochemists (1500–1650) devoted their chemical pursuits to alleviation of disease. During the phlogiston period (1650–1774) men postulated a hypothetical matter whose presence was required for combustion and calcination. Gain in weight by calcination of metals led to a search for a very light material and subsequent discovery of gases, one of which was oxygen, and the answer to the problem. This is the date when modern chemistry begins.

When qualitative and quantitative analysis had identified enough pure substances, inorganic chemistry grew in scope. Organic chemistry was little understood until 1828 when synthesis of urea by Friederich Wöhler (1800–1828), a German chemist, proved that the "vital force" which was considered imperative to produce compounds that occurred in living matter was not needed.

Meanwhile reliable physical and chemical measurement began with the laws of Boyle (1660), Charles (1785), Gay-Lussac (1808) and Dalton (1807). Dalton's atomic theory (1807), postulated after the laws of the conservation of mass and definite proportions were tacitly assumed, stimulated the 19th-century effort to determine accurate atomic weights,

ideas for combination as expressed in valence*, and the studies of molecular structure until the three-dimentional models appeared.

Gradual determination of physical properties of the elements indicated a periodicity of property expressed by the periodic law which has withstood the onslaught** of the discovery of the subatomic particles which make up the nucleus and outer electrons of the atom.

Words and Word-Combinations to Be Memorized

accurate, A. D., ancient, approach, assume, comprise, date, definite, determine, effort, express, force, gain, goal, gold, gradual, improve, inorganic, matter, model, organic, outer, particle, principal, problem, prove, qualitative, reliable, require, stimulate, subsequent, synthesis, technique, there be, until, urea, withstand

Ex. 5. Give the Russian equivalents for the following:

the history of chemistry, an ancient period, comprize, civilization, develop, a philosophical approach to, a theory of numbers, a theory of elements, propose, the alchemical period, the principal goal, base metals, change to, introduce, pure substance, an improved technique, devote, during the period, postulate, a hypothetical matter, require, gain in weight, the answer to the problem, identify a substance, synthesis of urea, produce a compound, reliable measurements, stimulate the effort, accurate weight, until, gradual, withstand smth., subatomic particles

Ex. 6. Give the English equivalents for the following:

древний период, в истории химии, метод изучения материи, атомная теория, теория элементов, теория чисел, земля, вода, воздух, огонь, главная цель, превратить в золото, чистое вещество, требовать, увеличение веса, очень легкое вещество, последующее открытие, современная химия, качественный/количественный анализ, определить вещество, органическая/неорганическая химия, синтез вещества, доказать, получить соединение, надежный метод, закон сохранения массы, определить точный вес, последующие попытки, новая модель, постепенный, указывать на периодичность, открытие частиц, составлять ядро, внешние электроны

Ex. 7. Fill in the blanks with prepositions where necessary.

1. There are five periods ... the history ... chemistry. 2. A philosophical approach ... the study ... matter was developed ... Greece. 3. Alchemists thought that there was a way ... which base metals could be changed ... gold. 4. ... the phlogiston period men postulated a hypothetical matter. 5. Gain ... weight ... calcination ... metals led ... a search ... a very light

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* as expressed in valence — выраженный валентностью

** has withstood the onslaught — выдержал атаку

material. 6. Organic chemistry was little understood ... the synthesis of urea ... Wöhler ... 1828. 7. Reliable physical and chemical measurements began ... the laws ... Boyle, Charles, Gay-Lussac and Dalton. 8. Subatomic particles make ... the nucleus ... the atom.

Ex. 8. Translate the sentences into Russian paying attention to different functions of the verb *do*.

1. *Do* it as quickly as you can. 2. *Do* you know when the periodic law was stated? 3. I can't *do* it now, I must be going. 4. The alchemists *did* improve techniques during their search of the philosopher's stone and an elixir of life. 5. They *do* synthesize new materials in their laboratory. 6. Scientists *did* not understand organic chemistry before the synthesis of urea. 7. He will have *done* it by 5 o'clock.

Ex. 9. Translate the sentences into Russian.

a) 1. In the period 350–1500 A. D. alchemists devoted their efforts to a search for the philosopher's stone. 2. Our understanding of atomic energy levels is based on modern advances in chemistry. 3. Reliable physical and chemical measurements stimulated the determination of accurate atomic weight. 4. Until the discovery of the subatomic particles, the structure of atoms was not fully understood. 5. These laws (the laws of the Conservation of Mass and Definite Proportions) were an important stimulation for the 19th-century chemistry. 6. The first period in the development of chemistry is the ancient period (until 350 A. D.). 7. There are five periods in the history of chemistry. 8. Mendeleyev's law of periodicity of elements has withstood the onslaught of the discovery of the subatomic particles. 9. Five "elements" (earth, air, fire, water and the quintessence) were considered by the ancients as the building blocks of matter.

b) 1. Is your text difficult? — It is easy. 2. Was the philosopher's stone found? — No, it was not. 3. What is this? — It is a text-book. 4. Whose book is it? — It is Nick's book. 5. It is a very interesting phenomenon. 6. It is winter. 7. It is snowing now. 8. It was early morning when we came to the laboratory. 9. It is a long way from our hostel to the university. 10. It is believed that Wöhler synthesized urea in 1828. 11. During the phlogiston period it was considered that some hypothetical matter was required for combustion and calcination. 12. It is necessary to know the periodicity in the history of chemistry. 13. It is never too late to learn. 14. It is chemistry that is my favourite subject. 15. It was Lomonosov who was the founder of Russian physico-chemical science. 16. It was early in the 19th century that Dalton founded his atomic theory. 17. It was after urea was synthesized that the development of organic chemistry was stimulated. 18. It was not the alchemical period which was the shortest in the history of chemistry. 19. It was not until qualitative and quantitative analysis had identified enough pure substances that inorganic chemistry grew in scope. 20. It was not until 1808 that Gay-Lussac's law was postulated. 21. Theirs was a very important discovery. 22. Ours is a most essential science. 23. These are the latest

journals. 24. Accurate measurements began with the laws of Boyle, Charles, Gay-Lussac and Dalton. These stimulated the efforts to determine accurate atomic weights. 25. How can one prepare urea? 26. One can express the idea for combination in valence. 27. Why does one call Mendeleyev's law the periodic law? 28. One must clearly understand the idea of chemical transformation. 29. One should be accurate in laboratory measurements.

Ex. 10. Translate the sentences into English.

1. В истории развития химии есть несколько периодов. 2. Еще в Древней Греции был разработан философский подход к изучению материи. 3. Нужно помнить, что главной целью периода алхимии был поиск философского камня. 4. Считали, что именно философский камень превращает обычные металлы в золото. 5. Только тогда, когда были разработаны методы количественного и качественного анализа, стало возможно получить достаточное количество чистых веществ. 6. Увеличение веса металлов при прокаливании привело впоследствии к открытию газов. 7. Что такое качественный анализ? 8. До 1928 года органическую химию мало понимали. 9. Многие ученые создавали свои модели строения атомов.

Ex. 11. Answer the following questions:

1. How many periods are there in the history of chemistry? 2. What are these periods? 3. What do you know about the ancient period? 4. What were the principal goals of the alchemical period? 5. What was the period of iatrochemistry devoted to? 6. Why is the period between 1650 and 1774 called the phlogiston period? 7. When does modern chemistry begin? 8. What stimulated the development of chemistry in the 19th century? 9. What investigations led to the discovery of the Periodic Law?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

instrumental, biochemistry, colloid, progress, fact, thermodynamics, structure, practical, application, standard, method, empirical, pioneer, geographic, plastic, gasoline, rocket, type, principle, correlation, interpretation, talent, energy, to confront, human, construction, limit

Упр. 2. Определите значения выделенных слов по контексту.

1. Twenty-first century chemistry *has narrowed* into different fields of chemistry such as analytical chemistry, physical chemistry, organic chemistry, etc. 2. Why were you absent at the classes, were you *ill*? 3. *Promise* little, but do much. 4. One of the most important among the past *achievements* of chemistry was the discovery of the atomic structure. 5. *Chemical engineers'* principal goal is to improve the technology of chemical production. 6. Almost all the students in our group are of the

same *age*. 7. *To explore* the phenomenon is to learn everything about it. 8. Comrade N will *replace* comrade B while he is away on holidays. 9. *Drugs* are substances used for medical purposes. 10. In future, oil and coal are to be replaced by new *fuels*, i. e., materials for producing heat or energy. 11. *Cancer* is one of the most serious diseases of the 21st century.

Слова к тексту:

assembly — сбор; **statement** — формулировка; **surpass** — превосходить; **create** — создавать; **environment** — окружающая среда; **assurance** — убежденность; **frontier** — граница; **miracle** — чудо; **superior** — лучший; **explosive** — взрывчатое вещество; **fibre** — волокно; **opportunity** — возможность; **benefit** — польза; выгода; **mankind** — человечество; **cure** — лекарство; **fabric** — ткань; **cell** — клетка

Text 13 B

Прочтите текст про себя (контрольное время — 4 минуты).

New Frontiers in Chemistry

Twenty-first-century chemistry has narrowed into units such as instrumental analysis, biochemistry, chemical engineering, and colloids. Chemistry has progressed from an assembly of facts to a statement of laws, and thermodynamics of chemical reactions to a study of atomic structure. It is also an age of practical applications which contribute to an improved standard of living. Man has learned to surpass nature as he explores the methods by which living matter is produced. To create a better environment, empirical studies of the past have been replaced by an assurance that any type of matter may be synthesized or analysed with time and effort.

The great frontiers of our world and our universe that await the explorer and the pioneer of the beginning of the twenty-first century are scientific rather than geographic. The past achievements of chemistry, the "miracle" drugs, the superior explosives, the new plastics, the synthetic fibres, the improved gasolines, and the rocket fuels, have received great publicity, but much remains to be done. New types of matter, new applications of known principles, and — most important of all — further correlation and interpretation of known facts and the development of new and more general principles await the coming of new scientific workers with energy, talent, and good training. In addition, there are great opportunities for those who would apply to the benefit of mankind the findings of science. Cures for cancer and other human ills are needed, as are new materials for construction to meet the needs of our daily life, better fabrics, stronger metals and plastics, and better sources of energy. As we live in the space age, new chemical problems confront us, and the great problem of the chemistry of the living cell is still with us, the promise for the future is unlimited.

Упр. 3. Передайте основное содержание текста в нескольких предложениях.

Упр. 4. Составьте план текста.

Упр. 5. Прочтите предложения и скажите, соответствуют ли они содержанию текста. Если нет, исправьте их.

1. Chemistry has made a great progress from an assembly of facts to a statement of laws. 2. Twentieth-century chemists didn't think about practical applications of their achievements. 3. In the ancient time there was no assurance that any type of matter may be synthesized or analysed with time and effort. 4. New geographic frontiers await the explorer. 5. Energy, talent and good training are needed for the development of new principles of science. 6. There are no more great opportunities for chemists. 7. New chemical problems confront us in the space age.

Упр. 6. Найдите в тексте и переведите на русский язык предложения, в которых дается представление о химии двадцатого столетия.

Section III

Ex. 1. Respond to the statements or questions using the following expressions: *as far as I know*; *as far as I remember*; *to my mind*; *it's hard to tell*; *if I am not mistaken*; *to tell the truth*.

Example: I don't remember when urea was synthesized. — To tell you the truth, I don't remember it either.

1. I didn't know that the alchemical period lasted so long. 2. What did Boyle state in his law? 3. When was Dalton's atomic theory introduced? 4. What country did Friederich Wöhler live in? 5. What period is considered as the beginning of modern chemistry? 6. What discoveries stimulated the development of chemistry in the 19th century? 7. Sorry to say, but I've never heard about phlogiston before. 8. Do you know how Dalton's model of the atom looked like? 9. What does the law of definite proportions state? 10. What is the difference between a compound and a mixture?

Ex. 2. Translate the sentences into English.

1. Если я не ошибаюсь, история развития химии делится на 5 периодов. 2. Именно поиски флогистона привели к открытию газов, если я не ошибаюсь. 3. Насколько я знаю, философский подход к изучению материи был разработан в Древней Греции. 4. Насколько я помню, чистые вещества впервые были получены алхимиками. 5. По-моему, одним из первых газов открыли кислород. 6. Почему люди так долго верили во флогистон? — Трудно сказать. 7. Чем отличается органическая химия от неорганической? — Трудно сказать в двух словах. 8. По правде говоря, мне трудно работать в лаборатории.

Ex. 3. Make up short dialogues according to the model.

Model: — *A general question.*
— *An answer (+, –).*

Example:
— Are you a student?
— Yes, I am. / No, I'm not.

Ex. 4. Give detailed answers to the questions.

1. What do you know about the periodicity in chemistry? 2. How did chemistry change with time? 3. What were the most important discoveries of the 19th century? 4. What can you say about the 20th-century chemistry?

Ex. 5. Discuss the following topics:

1. The Achievements of the Ancient Civilizations.
2. The Principal Discoveries in the History of Chemistry and their Importance.
3. The Twenty-First-Century Chemistry.
4. New Frontiers in Chemistry.

WHAT IS IT?

A substance which cannot be divided into a simpler one by ordinary chemical methods.

Lesson 14

ГРАММАТИКА: Оборот «именительный падеж с инфинитивом».

Section I

Ex. 1. Practise your pronunciation.

a) thought [θɔ:t], continuous [kən'tɪnjʊəs], surface ['sɜ:fɪs], argue ['ɑ:gju:], infinitely ['ɪnfɪnɪtlɪ], inquire [ɪn'kwaɪə], perceive [pə'si:v], vegetable ['vedʒɪtəbl], variety [və'raɪətɪ], brought [brɔ:t], couple [kʌpl], relatively ['relətɪvlɪ], indivisibility [ɪndɪˌvɪzə'bɪlɪtɪ], guess [ges], knowledge ['nɒlɪdʒ], systematize ['sɪstəmətaɪz]

b) of◡the◝atom, 'out◡of◝which, in◡the◝world, at◡the◝surface, 'they◡be◝lieved, ◝argued◡that, 'gave◡the◝name, and◡ the◡◝particles, in◡a 'striking ◝way

c) To◜day 'all 'atoms are 'recognized | to con'sist of 'smaller◝particles.

Ex. 2. Pay attention to the structure of the following words; translate them into Russian:

a) unusual, unable, unstable, unjust, unnecessary, unsuccessful, unemployed, unlimited, uncuttable

b) inorganic, indirect, insoluble, independent, incorrect, incapable, indefinite, indifferent, inseparable, indivisibility

c) impossible, imperfect, improbable, improper, immaterial, impersonal, immeasurable, impractical

Ex. 3. Define the meanings of the word *because* in the following sentences:

1. Mendeleyev's mother could not place Dmitry in the University of Moscow *because* he had been born in Siberia. 2. The government retired Mendeleyev from the University of St. Petersburg *because* of his social activity. 3. Mendeleyev could not present his paper on the periodic table at the meeting of the Russian chemical society himself *because* he was ill. 4. Elements in the same group of the periodic table are sometimes called congeners *because* they possess similar properties. 5. Electrolysis of water is not widely used to obtain ozone *because* of its low efficiency. 6. *Because* of the difference in the vapour pressure of ozone and oxygen it is possible to separate them. 7. Lavoisier named the gas "hydrogen" (water-former) *because* of its ability to form water in combination with oxygen. 8. Selenium received almost no attention in textbooks *because* it was not commercially used.

Ex. 4. Find the predicate and the subject in the following sentences:

1. The solid matter was believed to be really continuous matter. 2. It was more logical to believe that all the varieties of matter are brought about by coupling together a relatively few kinds of particles. 3. This purely philosophical guess turned to be confirmed later. 4. Atoms are made of fundamental particles, they are called building blocks of all matter. 5. Ancient Greeks were right in the ultimate sense of the argument.

Text 14 A

The Idea of the Atom

Many times during the course of history men believed that the solid matter, of which the different things in the world are made, was really continuous matter. They thought that if you could look at the surface of a stone with magnificaton unlimited, you would always see a continuous surface, no matter how much you turned up the magnification. They believed that you would not find individual particles like atoms and electrons. They argued that if you had a magic knife by which you could cut the stone into smaller and smaller pieces, you could continue cutting it up indefinitely and could make the pieces as small as you like — a trillion, quadrillion, quintillion times smaller or even infinitely small. But some twenty-five hundred years ago, there lived in Greece a group of men with inquiring minds, who perceived that this argument for continuous matter was not sound. Facing the fact that the world contains so many different kinds of matter — stones, metals, vegetables matter, animal matter, solids and liquids of so many forms — they argued that it was more logical to believe that all

these varieties of matter are brought about by coupling together a relatively few kinds of particles, which could not be cut up any further. Because the indivisibility was taken to be the fundamental property of these particles, they gave them the name *atom*, or *a-tom* which in Greek means *uncuttable*. It is astonishing that this purely philosophical guess turned to be confirmed so completely two thousand five hundred years later. Of course, today all atoms are cuttable into smaller particles, such as the electrons in the outer shells and the fundamental particles in the inside of the nucleus; but the truly fundamental particles of which atoms are made, are sure to be uncuttable and they are true building blocks of all matter.

During the period of fourteen years beginning with 1897, it was discovered that atoms are composed of smaller particles. The discovery of the components of atoms and the investigation of the structure of atoms is likely to be one of the most interesting stories in the history of science. Moreover, knowledge about the electronic structure of atoms has made it possible to systematize the facts of chemistry in a striking way, making the subject easier to understand and to remember: it has been discovered that the bonds that hold atoms together in molecules, consist of pairs of electrons held jointly by two atoms. So those ancient Greeks were right in the ultimate sense of the argument.

Words and Word-Combinations to Be Memorized

argue, believe, bring about, confirm, continuous, course, of course, fundamental, hold, individual, infinite, inside, jointly, kind, likely, mind, moreover, out of, really, relatively, science, sense, shell, sound, sure, systematize, turn, ultimate, vegetable

Ex. 5. Give the Russian equivalents for the following:

during the course of history, unlimited magnification, perceive, a sound argument, bring about, a fundamental property, a purely philosophical guess, confirm, in the outer shells, be composed of particles, be likely, moreover, knowledge about the structure, in a striking way, make something easier understand, hold together, jointly, in the sense

Ex. 6. Give the English equivalents for the following:

много раз, твердое вещество, из которых, посмотреть на поверхность, отдельные частицы, разрезать на более мелкие куски, столкнуться с фактом, много различных видов, относительно немного, полностью подтвердить, фундаментальные частицы, внутри ядра, состоять из, компоненты атомов, электронное строение атомов, систематизировать факты, связь, удерживать вместе

Ex. 7. Fill in the blanks with prepositions where necessary.

1. Long ago there lived ... Greece a group ... men ... inquiring minds. 2. They named ... the particle "atom" because ... its indivisibility.

3. Atom means "indivisible" ... Greek. 4. Of course, today atoms are known to consist ... still smaller particles. 5. The discovery ... the components ... atoms is one ... the most interesting stories ... the history ... science. 6. Knowledge ... the structure ... atoms made it possible to systematize the facts ... chemistry ... a striking way. 7. Atoms are held together ... molecules ... bonds.

Ex. 8. Translate the sentences into Russian paying attention to different functions of *it*.

1. *It* was believed that all the varieties of matter were brought about by a relatively few kinds of particles. 2. *It* is astonishing that a purely philosophical guess about the structure of an atom was so completely confirmed. 3. An atom is no longer thought to be a fundamental particle, *it* consists of still smaller particles. 4. Knowledge about the electronic structure of atoms made *it* possible to systematize the facts of chemistry. 5. *It* was discovered that bonds hold atoms together. 6. *It* was in Greece that first ideas about the structure of matter appeared. 7. There are some unknown words in the text, translate *it* using a dictionary. 8. *It* was not until the 19th century that the periodicity of elements was discovered. 9. Bring the book, please, *it* is on the table. 10. *It* is a new law; you must clearly understand *it*.

Ex. 9. Translate the sentences into Russian.

1. The subject of chemistry appears to be one of the principal subjects. 2. The hypothesis is likely to be confirmed soon. 3. An atom was considered by the ancients to be an indivisible particle. 4. The approach is sure to attract the attention of the scientists. 5. These new results are likely to be widely discussed. 6. At first the discovery did not seem to be very important. 7. The experiment is not likely to be finished at 5. 8. Calculations are said to have confirmed this idea. 9. Fundamental particles are regarded to be indivisible. 10. The atom has long been believed to be a simple particle. 11. Nobody was supposed to be informed about the observed phenomenon. 12. The reaction is supposed to give a good yield. 13. The library is reported to have got many foreign journals this month. 14. The symposium was heard to be a great success. 15. The composition of membranes was expected to be described in the next chapter. 16. Their laboratory was known to have been investigating the properties of electrodes for some ten years. 17. In old times air was thought not to be matter of any kind. 18. A reaction may be shown to occur under ordinary conditions. 19. There are known to exist several modifications of phosphorus. 20. Sulphur might be expected to occur in a number of different forms. 21. Bromine happened to be prepared in 1826. 22. Chemical industry may be said to have begun in the 19th century.

Ex. 10. Translate the sentences into English.

1. Древние считали, что основное свойство атомов — неделимость. 2. Оказалось, что их предположение подтвердилось. 3. Се-

годня признают, что атомы состоят из меньших частиц. 4. Считается, что все вещества состоят из фундаментальных частиц. 5. Открытие структуры атома, вероятно, явилось одним из важнейших открытий в науке. 6. Конечно, знание строения атома сыграло важную роль в развитии химии.

Ex. 11. Answer the following questions:

1. What did the ancients think about the composition of matter? 2. What particles were considered to be the building blocks of matter? 3. What does the word "atom" mean? 4. What was known about the structure of the atom at the beginning of the 20th century? 5. What do we call fundamental particles now? 6. In what way are atoms held together in a molecule?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

philosopher, vacuum, absolutely, identical, combination, conservation, mass, constant, proportion

Упр. 2. Определите значения выделенных слов по контексту.

1. The number of students in this group *diminished* from 15 to 13 after the first session. 2. *Speculation* about the periodicity of properties led to the discovery of the periodic law. 3. The method is very *useful* for accurate measurements, usually it gives good results. 4. The coat is too small for you, it's not your *size*. 5. The idea has not been *adopted* until recently.

Слова к тексту:

superficial — *зд.* незначительный; **smooth** — гладкий; **roll** — вращаться; **rough** — грубый; **jagged** — зазубренный; **cling** — цепляться, прилипать; **reasonable** — разумный; приемлемый

Text 14 B

Прочтите текст про себя (контрольное время чтения — 3 минуты).

The Atomic Theory of Democritus and Dalton

The Greek philosopher Democritus (about 460–370 B.C.) who had adopted some of his ideas from earlier philosophers, stated that the Universe is composed of void (vacuum) and atoms. The atoms were considered to be everlasting and indivisible — absolutely small, so small that their size could not be diminished. The atoms of different substances, such as water and iron, were considered by him to be fundamentally the same, but to differ in some superficial way; atoms of water, being smooth and round, could roll over one another, whereas atoms of iron, being rough and jagged, would cling together to form a solid body. The atomic theory of Democritus

was pure speculation, and was much too general to be useful. Dalton's atomic theory, however, was a hypothesis that explained many facts in a simple and reasonable way.

Dalton stated the hypothesis that elements consist of atoms, all of the atoms of one element being identical*, and that compounds result from the combination of atoms of two or more elements, each in definite number. In this way, he could give a simple explanation of the law of conservation of mass and of the law of constant proportions.

Упр. 3. Передайте основное содержание текста в нескольких предложениях.

Упр. 4. Составьте план текста.

Упр. 5. Прочтите предложения и скажите, соответствуют ли они содержанию текста. Если нет, исправьте их.

1. The Greek philosopher Democritus was the first who stated that matter is composed of atoms. 2. The atoms were considered to be small indivisible particles. 3. The atoms of different substances were considered by Democritus to be different. 4. The atomic theory of Democritus was not useful because it was too general. 5. Dalton stated that all of the atoms of one element were the same. 6. Dalton could not explain the law of conservation of mass.

Упр. 6. Найдите в тексте предложения с описанием того, как Демокрит представлял себе атомы, и переведите их на русский язык.

Section III

Ex. 1. Answer the questions. Use the verb *take*.

1. Do your experiments take much time? 2. Have you taken your exam in English? 3. When are you going to take your holidays? 4. Does your friend take interest in chemistry? 5. When are you going to take your examination in mathematics? 6. Who took the first prize in swimming? 7. Are you going to take post-graduate studies? 8. Do you take interest in modern music? 9. How long does it usually take you to get here? 10..How long did it take you to do the exercise? 11. Do you take part in social activity? 12. Have you taken my pen? 13. When did you first think to take up chemistry as your field?

Ex. 2. Translate the sentences into English.

1. Весной я буду сдавать четыре экзамена. 2. Я слышал, что ваш друг интересуется физикой. 3. Он не интересуется наукой. 4. Завтра у

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* **all of the atoms of one element being identical** — причем все атомы одного элемента являются идентичными

нас семинар по истории, я должен принять в нем участие. 5. Кто занял второе место по волейболу? 6. Сколько времени у вас занял перевод? 7. Вчера я добрался до университета за 40 минут.

Ex. 3. Make up short dialogues according to the model.

Model: — *A special question.*
— *An answer.*

Examples:

1) — What is it?
— It is a book.

2) — When did you come?
— At 5 o'clock.

Ex. 4. Give detailed answers to the questions.

1. In what way did the idea of the atom change in the course of history? 2. What scientist stimulated the development of the atomic theory? 3. What do you know about the atomic structure?

Ex. 5. Discuss the following topics:

1. Early Atomic Theories.
2. The Present Ideas about the Structure of Matter.
3. The Most Important Discoveries Concerning the Atomic Structure.

WHAT IS IT?

The smallest unit of an element that can take part in a chemical change.

Lesson 15

ГРАММАТИКА: Некоторые особенности перевода на русский язык оборота «именительный падеж с инфинитивом». Оборот «именительный падеж с причастием, прилагательным, числительным».

Section I

Ex. 1. Practise your pronunciation.

a) physicist ['fɪzɪsɪst], previously ['pri:vjəslɪ], among [ə'mʌŋ], weight [weɪt], aggregate ['ægrɪgət], encyclopaedia [ɪn‚saɪklə'pi:dɪə], distinguish [dɪs'tɪŋgwɪʃ], although [ɔ:l'ðəʊ], unchallengeable [ʌn'tʃælɪndʒəbl], predecessor ['pri:dɪsesə], half [hɑ:f], precise [prɪ'saɪs]

b) 'called‿the\particles, 'these\particles, the‿'Greek\word, the‿'rapid \progress, is‿'well‿illus\trated, in‿the‿'early\years, 'ends‿with‿the\words, 'thought‿that, are‿in\'favour, in‿favour‿of‿the\theory, 'half‿a‿'century\later

c) /'Now | we have pre'cise knowledge | of the 'structure and 'properties | of 'atoms and \molecules.

Ex. 2. Pay attention to the structure of the following words. Translate them into Russian:

a) 'extract — ex'tract, 'progress — pro'gress, 'import — im'port, 'export — ex'port, 'increase — in'crease, 'present — pre'sent, 'compound — com'pound, pre'cipitate — precipi'tate

b) physics, mathematics, economics, dynamics, electronics

c) irregular, irrespective, irrational, irrecognizable, irreligious, irremovable, irreplaceable

Ex. 3. Define the meanings of the word *about* in the following sentences:

1. Our knowledge *about* atoms greatly increased during the twentieth century. 2. The student was *about* to come into the room when I stopped him. 3. A theory usually involves some idea *about* the nature of some part of the Universe. 4. The mixture is *about* to explode, stop heating it. 5. At what time do you usually get up? — At *about* 7. 6. They were *about* to leave when the telephone rang. 7. The Mendeleyev system has served for *about* a century as a key to discovering new elements. 8. *About* one-fifth of the air by volume is oxygen. 9. There is nothing special *about* this process. 10. You know too little *about* selenium.

Ex. 4. Find the predicate and the subject in the following sentences:

1. As it was verified by further work in chemistry and physics, Dalton's atomic hypothesis became the atomic theory. 2. In the early years of the twentieth century, atoms were defined as the imaginary units. 3. It has more than once happened in the history of science that a hypothesis has been abandoned.

Text 15 A

The Atomic Theory

In 1805 the English chemist and physicist John Dalton (1766–1844) put forward the hypothesis according to which all substances were stated to consist of small particles of matter, of several different kinds, corresponding to the different elements. He called these particles atoms, from the Greek word *atomos*, meaning "indivisible". This hypothesis gave a simple explanation or picture of previously observed but unsatisfactorily explained relations among the weights of substances taking part in chemical reactions with one another. As it was verified by further work in chemistry and physics, Dalton's atomic hypothesis became the atomic theory.

The rapid progress of science during the twentieth century is well illustrated by the increase in our knowledge about atoms. In a popular textbook of chemistry written in the early years of the twentieth century, atoms were defined to be the "imaginary units" of which bodies are aggregates. The article in "Atom" in the 11th edition of the *Encyclopaedia Britannica*, published in 1910, ends with the words "The atomic theory

has been of priceless value to chemists, but it has more than once happened in the history of science that a hypothesis, after having been useful in the discovery and the coordination of knowledge, has been abandoned and replaced by one more in harmony with later discoveries. Some distinguished chemists thought that this fate may be awaiting the atomic theory... But modern discoveries in radioactivity are in favour of the existence of the atom, although they lead to the belief that the atom is likely to be not so eternal and unchangeable a thing as Dalton and his predecessors had imagined".

Only half a century later, scientists had precise knowledge of the structure and properties of atoms and molecules. Atoms and molecules can no longer be considered "imaginary".

Words and Word-Combinations to Be Memorized

article, current, define, distinguish, explanation, in favour of, illustrate, increase, no longer, more than once, physicist, physics, popular, precise, previously, price, priceless, progress, put forward, radioactivity, rapid, replace, satisfactory, useful, be of value

Ex. 5. Give the Russian equivalents for the following:

put forward a hypothesis, according to the atomic theory, give an explanation, previously observed relations, by further work, rapid progress, during the current century, be illustrated by smth., imaginary units, be of value, replace a hypothesis by a theory, a distinguished chemist, discoveries in radioactivity, be in favour of smth., imagine, have precise knowledge, no longer

Ex. 6. Give the English equivalents for the following:

выдвинуть идею, согласно теории, дать простое объяснение, объяснить факт, принять участие в реакции, друг с другом, популярная книга, третье издание, опубликовать статью, заменить одну идею другой, выдающийся ученый, доводы в пользу гипотезы, спустя полстолетия, больше не может рассматриваться, увеличение радиоактивности, не один раз, ранее неизвестная величина, быстрое развитие

Ex. 7. Fill in the blanks with prepositions where necessary.

1. Dalton's theory was put ... 1805. 2. The hypothesis could not explain ... relations ... the weights ... substances taking part ... chemical reactions. 3. The atomic theory is ... priceless value ... chemists. 4. Modern discoveries ... radioactivity are ... the existence ... the atom. 5. Half ... a century later the atomic structure became clear. 6. The atomic theory is useful ... the coordination ... knowledge. 7. Dalton's atomic hypothesis was verified ... further work ... chemistry and physics.

Ex. 8. Translate the sentences into Russian paying attention to different functions of *for*.

1. The atomic theory was of great value *for* further development of science. 2. Dalton's hypothesis became the atomic theory, *for* it was verified by later discoveries. 3. *For* this reason the hypothesis was replaced by another one. 4. This technique is recommended to be used, *for* it is very accurate. 5. Argon and other gases of this group are called inert, *for* they are chemically inactive. 6. The theory hasn't been recognized *for* almost a century.

Ex. 9. Translate the sentences into Russian.

a) 1. Dalton's hypothesis was later proved to be true. 2. Fundamental particles are no longer considered to be non-existent. 3. Radioactivity is known to be affected by the presence of other elements which are not radioactive. 4. Air was later found not to be an element. 5. Hydrogen does not appear to react quickly with chlorine in the dark. 6. Pure liquid HCl does not seem to be conductor of electricity. 7. Under certain conditions an atom of hydrogen may be regarded to be acting as a bond. 8. There appears to be no difficulty in determining the rate of this reaction. 9. There seems to be no evidence in favour of your idea. 10. The phenomenon has never been observed to occur under ordinary conditions. 11. Chlorine is stated to have been discovered in 1774. 12. Solid carbon is usually said to exist in three modifications. 13. Mendeleyev is known to have been born in Tobolsk. 14. The law of conservation of mass is known to have been definitely stated by the great Russian scientist M. V. Lomonosov in 1756. 15. H_2SO_4 does not appear to have been known to the ancient world.

b) 1. The symbol H_2SO_4 is interpreted as representing one molecule of sulphuric acid. 2. Acids are usually thought of as being liquids. 3. According to the atomic theory, a molecule is considered as being composed of atoms. 4. The periodic classification should be mentioned as having been the principal discovery of the 19th century. 5. A nucleus is now regarded as being composed of fundamental particles. 6. All substances may be regarded as soluble in water. 7. Atoms are no longer considered "imaginary". 8. The valency of carbon is usually thought of as four. 9. Water is known as composed of two elements: hydrogen and oxygen. 10. Substances are usually defined as having a definite composition.

Ex. 10. Translate the sentences into English.

1. Джон Дальтон был химиком и физиком. 2. Он жил в Англии с 1766 по 1844 год. 3. Более всего он известен своей атомистической теорией. 4. Дальтон выдвинул свою теорию строения элементов в 1805 году. 5. Эта теория была подтверждена дальнейшими исследованиями. 6. Позднее она была развита в соответствии с современными исследованиями. 7. Современная наука располагает точными знаниями о структуре и свойствах атомов и молекул. 8. Теперь никто больше не может утверждать, что структура и состав атомов неизвестны.

Ex. 11. Answer the following questions:

1. When was Dalton's atomic hypothesis put forward? 2. What was the main idea of this hypothesis? 3. In what way was the hypothesis verified? 4. What does sometimes happen to a hypothesis in the course of history? 5. Was Dalton's hypothesis forgotten later? 6. What do modern scientists think about Dalton's theory?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

electronic, arc, refract, diffract, line, spectrum, progress, interpretation, regularity, especially, physicist, quantum, problem, extraordinary

Упр. 2. Определите значения выделенных слов по контексту.

1. Hertz is a unit of *frequency*. 2. The discovery of the atomic structure *laid the basis* for further discoveries in science. 3. The measurements must be made very *carefully*. 4. Heat and light are often *emitted* during the reaction. 5. When we use some example in our work, one can say that we work according to *a pattern*.

Слова к тексту:

excite — возбуждать; **spark** — искра; **distinctive** — отчетливый; **achieve** — достигать; **successfully** — успешно; **advance** — улучшение, прогресс

Text 15 B

Прочтите текст про себя (контрольное время чтения — 3 минуты).

The Bohr Theory of the Hydrogen Atom

Most our knowledge of the electronic structure of atoms has been obtained by the study of the light given out by atoms when they are excited by high temperature or by an electric arc or spark. The light that is emitted by atoms of a given substance can be refracted or diffracted into a distinctive pattern of lines of certain frequencies; such a distinctive pattern of lines is said to be the line spectrum of the atom.

The careful study of line spectra began about 1880. Early investigators made some progress in the interpretation of spectra, in recognizing regularities in the frequencies of the lines: the frequencies of the spectral lines of the hydrogen atom, for example, show an especially simple relationship with one another. It was not until 1913, however, that the interpretation of the spectrum of hydrogen in terms of the electronic structure of the hydrogen atom was achieved. In that year, the Danish physicist Niels Bohr (1885–1962) successfully applied the quantum theory to this problem, and laid the basis for the extraordinary advance in our understanding of the nature of matter that has been made since then.

Упр. 3. Передайте основное содержание текста в нескольких предложениях.

Упр. 4. Составьте план текста.

Упр. 5. Прочтите предложения и скажите, соответствуют ли они содержанию текста. Если нет, исправьте их.

1. There was only one atomic theory in the history of chemistry. 2. The light that is emitted by atoms of a given substance gives a distinctive pattern. 3. The line spectrum is the spectrum of an atom but not a molecule. 4. The result of early investigations was that the line spectra of the hydrogen atom were not alike. 5. Niels Bohr was not interested in studying spectral lines. 6. The application of the quantum theory helped to understand the electronic structure of the hydrogen atom better.

Упр. 6. Найдите в тексте и переведите на русский язык предложения, где идет речь об образовании линейного спектра.

Section III

Ex. 1. Respond to the following requests and invitations. Use the expressions: *with pleasure, here you are, certainly, of course.*

1. Shall we go to the University together? 2. Give me your textbook for some days, please. 3. Will you help me to do the exercise? 4. Please bring me my notebook, you'll find it on the table. 5. Let's spend Sunday together. 6. Let's go for a walk after finishing our homework. 7. Have you been to the Russian Museum? Let's go there with Mary, she knows a lot about Russian art. 8. Could you show me the way to the laboratory of organic chemistry, please?

Ex. 2. Translate the sentences into English.

1. Пойдем завтра в кино? — С удовольствием. 2. Дай мне, пожалуйста, ручку на минутку. — Пожалуйста. 3. Приходи ко мне вечером, я дам тебе эту книгу. — С удовольствием. 4. Ты придешь завтра на семинар? — Конечно. 5. Ты не видел, где моя тетрадь? — Вот она. 6. Не забудь принести мне эту статью завтра. — Конечно. 7. Помоги мне закончить опыт, пожалуйста. — С удовольствием.

Ex. 3. Make up short dialogues according to the model.

Model: — *An alternative question.*
— *An answer.*

Example:

— Are you a student or a post-graduate?
— I'm a student.

Ex. 4. Give detailed answers to the following questions:

1. What kind of particle is called an atom? 2. What was Dalton's idea of an atom? 3. What is the difference between Dalton's and modern theory

of the atomic structure? 4. In what way did Bohr's work develop the atomic theory? 5. What relationship is there between an atom and its spectrum?

Ex. 5. Discuss the following topics:

1. The Evolution of the Atomic Theory.
2. The Modern Concept of the Composition and Structure of an Atom.
3. The Basis for Spectral Analysis.

WHAT IS IT?

An optical instrument for forming and examining spectra.

Lesson 16

ГРАММАТИКА: Инфинитив и инфинитивный оборот в функции подлежащего.

Section I

Ex. 1. Practise your pronunciation.

a) molecule ['mɔlikju:l], peculiar [pɪ'kju:lɪə], rearrangement [ˌri:ə'reɪn-dʒmənt], neutral ['nju:trəl], other ['ʌðə], exemplify [ɪg'zæmplɪfaɪ], chlorine ['klɔ:ri:n], compound ['kɔmpaʊnd], existence [ɪg'zɪstəns], exhibit [ɪg'zɪbɪt], sample [sɑ:mpl], diatomic [ˌdaɪə'tɔmɪk]

b) the◡'modern\chemist, the◡'smallest\particle, into◡a◡'chemical◡re\action, the◡'other\elements, in◡'which◡'they\bear, of◡their◡'own\kind, by◡the◡'water \molecule, are◡of im\portance

c) 'Chemical 'unions | are of 'two 'general\types.

Ex. 2. Pay attention to the structure of the following words. Translate them into Russian.

a) reread, rewrite, reappear, recombine, replace, reproduce, redistribute, rearrange, remake

b) colour, neighbour, behaviour, favour, vapour

c) friendship, leadership, relationship, hardship, professorship

Ex. 3. Define the meanings of the word *kind* in the following sentences:

1. I'm sure, the professor will help you, he is very *kind*. 2. What *kind* of substance is it? 3. Compound molecules are composed of two or more *kinds* of atoms. 4. What *kind* of man is he? 5. Be so *kind* as to shut the door. 6. There are different *kinds* of animals on the earth. 7. Everybody knows that your mother is very *kind*. 8. I don't like stories of this *kind*. 9. I hear he is good at mathematics. — Nothing of the *kind*, he always asks to help him with the problems.

Ex. 4. Find the predicate and the subject in the following sentences:

1. To the modern chemist, the atom is the smallest particle of an element that can enter into a chemical reaction. 2. To think of a molecule is to think of the atoms which it contains and their proportion. 3. In compounds, molecules of two or more kinds of atoms become bonded together. 4. For the reaction to start, two conditions must be met.

Text 16 A

Molecules

To the modern chemist, the atom is the smallest particle of an element that can enter into a chemical reaction. Thus, each element has atoms that are peculiar to itself and different from those of each of the other elements. Chemical reactions occur when atoms of different kinds unite to form groups in which they bear definite relationships to each other or when these groups undergo disruption or rearrangement. Chemical unions are of two general types.

In one type of union, atoms become bonded together to form definite aggregates that exist as independent, electrically neutral particles and are known as molecules (Latin "little mass"). Some elements have atoms that unite with others of their own kind to form molecules. These are known as elemental molecules and are exemplified by the chlorine molecule which is made up of two chlorine atoms. Compound molecules are composed of two or more kinds of atoms and are exemplified by the water molecule, which contains two atoms of hydrogen and one of oxygen.

To give a short definition of a molecule is not to give a more or less full account of properties.

Molecules are regarded as the smallest particles or elementary substances that can have independent existence. They account for the chemical properties and at least some of the physical properties of the substance they constitute. A single molecule does not exhibit in full the physical properties commonly associated with its particular variety of matter. These properties arise both within the molecule itself and within the aggregates of like molecules that constitute a sample of the given substance. The density of water depends not only on the mass and volume of indivilual molecules but also on the manner in which the molecules are packed together. Since the chemist works with the aggregates, their properties are of great practical importance.

A molecule of a compound contains, of necessity, at least two different atoms. An element molecule may contain only one atom, or it may contain two or more. Helium has monoatomic molecules; chlorine and hydrogen each exist as diatomic molecules; and sulphur molecules contain eight atoms. During reactions the atoms of elemental molecules usually are separated and individually redistributed in new combinations.

arise, be made up of, be of importance, both... and, commonly, constitute, definition, density, depend (on), distribute, each other, helium, independent, at least, manner, more, neutral, pack, particular, rearrangement, relationship, sample, those, type, union, within

Ex. 5. Give the Russian equivalents for the following:

enter into a chemical reaction, be different from each other, occur, definite relationships, undergo rearrangement, chemical unions, become bonded together, form definite aggregates, be exemplified by, give a full account of, account for chemical properties, a single molecule, exhibit a property, arise within the molecule itself, density, depend on the mass, pack the molecules together, be of great practical importance, contain two or more atoms, exist as diatomic molecules

Ex. 6. Give the English equivalents for the following:

каждый элемент, вступать в химическую реакцию, отличаться от, электрически нейтральный, молекула хлора, состоять из, сложная молекула, молекула соединения, состоять из нескольких видов атомов, молекула воды, краткое определение, более или менее полный, по крайней мере, некоторые из свойств, отдельная молекула, в самой молекуле, образец данного вещества, плотность (удельный вес) вещества, зависеть от, иметь практическое значение, одноатомная молекула

Ex. 7. Fill in the blanks with prepositions where necessary.

1. The smallest particle of an element that can enter ... a chemical reaction is an atom. 2. The lecture has already begun, don't enter ... the classroom, please. 3. Elements differ ... each other. 4. Atoms ... different kinds can unite and form a molecule ... a compound. 5. Elemental molecules are composed ... the atoms ... the same kind. 6. Chlorine molecule is made ... two chlorine atoms. 7. This definition does not give a full account ... the properties of a molecule. 8. The density ... a substance can be easily calculated, it depends ... its mass and volume.

Ex. 8. Translate the sentences into Russian, paying attention to different functions of *since*.

1. We call the atomic hypothesis a theory, *since* it has been verified by further discoveries. 2. Bohr's atomic theory has been known *since* 1913. 3. Chemistry has changed greatly *since* 1869 when the periodic law was published. 4. The periodic system has long *since* served as the greatest contribution to science. 5. *Since* the combustion of many nonmetals yielded products which reacted with water and gave acidic

solutions, Lavoisier named the newly-discovered gas oxygen ("acid former"). 6. Ever *since* Lavoisier in 1792 demonstrated that diamond and graphite are allotropic forms of carbon, man has been interested in converting carbon into diamond. 7. They left St. Petersburg in 1996, they haven't been there *since* then.

Ex. 9. Translate the sentences into Russian.

1. To analyse a substance means to define its components. 2. To have a laboratory practice work is very useful for students of chemistry. 3. To know the atomic structure is to understand this phenomenon. 4. To give a short definition of a molecule is not so very easy. 5. For uranium minerals to be used in industry is not a usual thing. 6. For atoms to have the same chemical properties is to be the atoms of one element. 7. To make accurate measurements requires great care. 8. To start a reaction is one thing, but to keep it going on is another. 9. For molecules to have the same composition implies the existence of the same structure. 10. To think about ordinary conditions of a reaction means to think about room temperature and 1-atm pressure. 11. To speak about the properties of halogens is first of all to mention their extraordinary activity. 12. For compounds to be bonded by a covalent bond implies having one or more shared electron pairs. 13. To compare the size of molecules is rather difficult. 14. To imagine a molecule of water means to imagine a certain combination of hydrogen and oxygen atoms. 15. To obtain a spectrum is to pass a beam of white light through a spectrograph. 16. To say that the density of a substance depends only on its mass and volume is to lose sight of the manner in which the molecules are packed together.

Ex. 10. Translate the sentences into English.

1. Атомы каждого элемента отличаются от атомов других элементов. 2. Химическая реакция происходит, когда атомы взаимодействуют друг с другом и образуют новые комбинации. 3. Молекулы, как известно, электрически нейтральны. 4. Молекулы соединений состоят из двух или более видов атомов. 5. Дать определение молекулы — значит сказать о ее составе и свойствах. 6. То, что соединения имеют одинаковые физические свойства, не означает, что их химические свойства тоже одинаковы. 7. Молекула элемента может состоять из одного, двух и более одинаковых атомов.

Ex. 11. Answer the following questions:

1. What is a chemical reaction? 2. What types of chemical unions do you know? 3. What is an elemental molecule? 4. What is a compound molecule? 5. What determines the properties of a molecule? 6. What composition an elemental molecule may have? 7. What is the difference between an atom and an elemental molecule?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

composition, identical, ozone, sort, dimethyl, amine, gas, electricity, covalent, ocean, ordinary, illuminate, optical, microscope, vision, especially

Упр. 2. Определите значения выделенных слов по контексту.

1. The boiling *point* of water is 100°C. 2. The *original* temperature of the solid was 23°C, then it was heated to 100°C. 3. When a thing is not *visible* by man's eye optical instruments should be used. 4. It is not possible to see atoms with the most *powerful* microscope. 5. Some substances *fail* to react at room temperature. 6. It is *claimed* that an electron microscope is a very useful instrument for molecular investigations.

Слова к тексту:

size — размер; **per** — на, в; **melt** — плавиться; **tiny** — крошечный; **meaningful** — имеющий смысл; **dye** — окрашивать; **throw** — бросать; **at random** — наугад; **exceedingly** — чрезвычайно; **directly** — прямо, непосредственно; **reveal** — обнаружить; **resolve** — *физ.* разрешать

Text 16 B

Прочтите текст про себя (контрольное время чтения — 4,5 минуты).

Molecular Composition and Size

Molecules are chemical units composed of one or more atoms. The simplest molecules contain one atom each; for example, helium atoms (one atom per molecule) are identical with helium molecules. Oxygen molecules (O_2) are composed of two atoms, and ozone (O_3) of three. Molecules may contain several different sorts of atoms. Water (H_2O) contains two different kinds, hydrogen and oxygen, and dimethyl amine ($(CH_3)_2NH$) has three kinds. Molecules of many common gases (hydrogen H_2, oxygen O_2, nitrogen N_2, and chlorine Cl_2) consist of two atoms each.

Not all molecules are molecular in structure. Some are atomic and many are ionic. Molecular substances are characterized by low boiling points and poor conductivity of electricity when dissolved or melted. Gases are generally molecular, and so are many liquids, and some solids. All compounds of hydrogen and non-metallic oxides are molecular. These compounds are considered to be bonded by a force called a covalent bond (or bonds) which consists of one or more shared electron pairs.

The size of molecules, especially of the smaller ones, is so tiny that to make a meaningful comparison is rather difficult. Let us assume that the water molecules in a cup of water are dyed so that they can be identified. If this cup had been thrown into the ocean 2,000 years ago, these molecules would have become distributed evenly in all bodies of water on the earth.

A cup of water taken at random from your nearest supply, would give you at least one hundred of the original dyed molecules. The exceedingly large number of molecules of water in a cup is, of course, directly related to the fact that each molecule is exceedingly small. Molecules are too small to be visible in ordinary light. The most powerful and best illuminated optical microscope has failed to reveal molecules by direct vision, although it is claimed that they have been resolved in the electron microscope.

Упр. 3. Передайте основное содержание текста в нескольких предложениях.

Упр. 4. Составьте план текста.

Упр. 5. Прочтите предложения и скажите, соответствуют ли они содержанию текста. Если нет, исправьте их.

1. Molecules usually contain several different kinds of atoms. 2. The water molecule is composed of two different sorts of atoms. 3. Molecules of all gases consist of two atoms. 4. Molecules may be molecular, atomic or ionic in structure. 5. There is no difficulty in comparing molecules by their size. 6. Molecules are too small and cannot be seen by ordinary means. 7. The electron microscope is the most powerful instrument that is used for molecular investigations.

Ex. 6. Найдите в тексте и переведите на русский язык предложения, где идет речь о молекулах, состоящих из разнородных атомов, а также предложения, в которых дается характеристика таких молекул.

Section III

Ex. 1. Respond to the following statements. Use the expressions: *you are right*; *yes, indeed*; *probably*; *you are not quite right*; *I can't agree with you.*

1. I hear you are leaving for Moscow today. 2. I think your work was very useful. 3. I think it would be better to speak to him. 4. Your results don't verify your hypothesis. 5. The lecture was not very easy to understand. 6. Your sister has just left school, hasn't she? 7. As far as I know, Niels Bohr was not only a great physicist but a distinguished philosopher as well. 8. If I am not mistaken, you are very good at sports.

Ex. 2. Translate the sentences into English.

1. Мне кажется, текст о молекулах совсем легкий. — Да, ты прав, он легче других текстов. 2. Мне говорили, что вы больны, а вы пришли на занятия. — Да, конечно, мне следует пойти домой. 3. Студенты вашей группы мало работают. — Вы не совсем правы, мы выполняем все, что необходимо. 4. В его работе много ошибок. — Не могу согласиться с вами, в его работе только одна серьезная ошибка. 5. Он скоро придет? — Вероятно. Он говорил, что придет к началу. 6. Вам надо повторить эксперимент. — Да, конечно, во вторник я сделаю все еще раз.

Ex. 3. Make up short dialogues according to the model.

Model: — *A disjunctive question.*
— *An answer.* (+, –)

Example:
— You are a student, aren't you?
— Yes, I am. / No, I'm not.

Ex. 4. Give detailed answers to the questions.

1. What is a molecule? 2. What determines the properties of molecules? 3. What kind of molecules are there? 4. In what way can the molecules be investigated? 5. What is the difference between the molecules of elements and compounds.

Ex. 5. Discuss the following topics:

1. Kinds of Molecules.
2. Molecular Composition and Structure.
3. Definition of a Molecule.

WHAT IS IT?

The smallest particle of matter that has the same chemical properties as the whole mass.

Lesson 17

ГРАММАТИКА: Герундий и герундиальный оборот в функции подлежащего.

Section I

Ex. 1. Practise your pronunciation.

a) equal ['i:kwəl], pressure ['preʃə], consequence ['kɒnsɪkwəns], gaseous ['gæsɪəs], weight [weɪt], cohesion [kəʊ'hi:ʒən], adjacent [ə'dʒeɪsənt], average ['ævərɪdʒ], neighbour ['neɪbə], vary ['veərɪ], cause [kɔ:z], measure ['meʒə], throughout [θru:'aʊt], obviously ['ɒbvɪəslɪ], above [ə'bʌv]

b) the ˌsame ˌnumber ˌof \molecules, at ˌthe ˌsame \pressure, through ˌthe \years, as ˌthose ˌin ˌa \gas, 'tend ˌto \form, a'bove ˌthe \liquid

c) The 'molecules in a 'liquid | are 'not 'all 'moving at the 'same ve\locity.

Ex. 2. Pay attention to the structure of the following words. Translate them into Russian.

a) overheat, overpressure, overgrow, overcome, overactive

b) non-crystalline, non-metal, non-metallic, non-standard, non-existent, non-agressive, non-conductor, non-effective, non-ferrous

c) outer, outwards, outstanding, output, outlet, outdoors, outcome, out-of-date, out-of-work, outdated, throughout

Ex. 3. Define the meaning of the word *result* in the following sentences:

1. The *results* of this experiment are extremely important for our future work. 2. As a rule, heating liquids *results* in their expansion. 3. It is necessary to test the obtained *result* by using another approach. 4. The production of the ions *results* from passing high energy radiation through atoms of the gas within the container. 5. The temperature rise *results* in the increase in kinetic energy of the molecules taking part in the reaction. 6. Investigation of such analogies *resulted* in the development of the nitrogen system of compounds.

Ex. 4. Find the predicate and the subject in the following sentences:

1. According to Avogadro's principle, the gram-molecular weight of any gaseous substance occupies 22.4 litres at standard temperature and pressure. 2. Liquids flow as a stream and tend to form drops to a greater or less extent. 3. Heating often results in the expansion of a body. 4. Boiling can be accomplished by raising the temperature of the liquid or by reducing the pressure of the atmosphere above the liquid.

Text 17 A

Molecules in Gases and Liquids

According to Avogadro's principle, equal volumes of gases regardless of composition, contain the same number of molecules at the same temperature and pressure. As a consequence of the principle, the gram-molecular weight of any gaseous substance occupies 22.4 litres at standard temperature (0°C) and pressure (760 mm of mercury). The number of molecules per gram-mole has been calculated by different methods of increasing refinement through the years, and is now considered to be 6.023×10^{23} atoms per gram-atom, or molecules per gram-mole), and it is accurate within 0.1%. For example, one mole of ammonia gas (NH_3 — weighs 17.073 grams, occupies a volume of 22.4 litre at standard temperature and pressure, and contains 6.023×10^{23} molecules).

At the same temperature, molecules of a liquid move at the same rate as those in a gas. In a liquid, however, the extent of motion must be more restricted. Liquids flow as a stream and tend to form drops to a greater or less extent, thus giving evidence of the importance of the force of cohesion between the molecules in a liquid. Heating liquids, as a rule, results in their expansion, an effect explained by the tendency of the molecules to occupy more space when they move at a faster rate. Also, increase in pressure has but slight effect on the volume compressible. From this evidence it is argued that molecules in a liquid are ajacent, close enough to flow in a continuous stream.

The molecules in a liquid, like those in a gas, are not all moving at the same velocity, but at the same average velocity at a given temperature. The molecules at the surface of a liquid, unlike those below the surface

layer, have no force of attraction from molecules above. Some of the more rapidly moving molecules overcome the cohesive force of their neighbour and leave the surface. The tendency to leave the surface or to evaporate varies from liquid to liquid, and it increases when the temperature is raised. The pressure caused by the evaporation of molecules from a liquid, measured at equilibrium with the returning molecules at a given temperature, is called the vapour pressure. In general, vapour pressure increases when the temperature rises. With continued addition of heat the vapour pressure rises still more until the vapour pressure reaches the vapour pressure of the atmosphere above the liquid. The evaporation goes on throughout the liquid, and the liquid is boiling. Obviously the act of boiling can be accomplished either by raising the temperature of the liquid or by reducing the pressure of the atmosphere above the liquid.

Words and Word-Combinations to Be Memorized

accomplish, ammonia, attraction, average, compress, consequence, equal, equilibrium, evaporation, expansion, extent, fast, flow, go on, layer, litre, mercury, motion, the number of, obviously, occupy, overcome, per, pressure, principle, raise, rate, reduce, regardless of, restrict, result in, return, as a rule, stream, tend, tendency, throughout, unlike, vapour, velocity, weight

Ex. 5. Give the Russian equivalents for the following:

as a consequence of this principle, the gram-molecular weight, calculate by different methods, be accurate within 0.1%, move at the same rate, to a greater extent, give evidence of, the force of cohesion, from this evidence, flow in a continuous stream, below the surface layer, overcome the force, rise still more, throughout the liquid, accomplish the boiling, either... or..., reduce pressure

Ex. 6. Give the English equvalents for the following:

равный объем, независимо от состава, одинаковое число молекул, при температуре, под давлением в одну атмосферу, быть ограниченным, в меньшей степени, таким образом, нагревание жидкости, как правило, приводить к, двигаться с большой скоростью, оказывать влияние на, со средней скоростью, при данной температуре, на поверхности жидкости, в отличие от, сила притяжения, тенденция к испарению, достичь атмосферного давления, продолжать нагревание, очевидно, или... или...

Ex. 7. Fill in the blanks with prepositions where necessary.

1. Liquids turn to form drops ... a greater or less extent. 2. One mole ... ammonia gas weighs ... 17.073 grams, occupies a volume ... 22.4 litres ... standard temperature and pressure. 3. The number ... molecules ... gram-mole was calculated ... different methods. 4. ... the same temperature,

molecules ... a liquid move ... the same rate as those ... a gas. 5. The effect ... increasing pressure ... the volume ... a liquid is only slight. 6. The tendency to evaporate varies ... liquid ... liquid. 7. ... general, vapour pressure increases when the temperature rises.

Ex. 8. Translate the sentences into Russian, paying attention to different functions of *as*.

1. *As* a consequence of Avogadro's principle, it is possible to determine the volume occupied by the gram-molecular weight of any gaseous substance at standard temperature and pressure. 2. Molecules of a liquid move at the same rate *as* those in a gas at equal temperatures. 3. Liquids can flow *as* a stream. 4. *As* a rule, there is a tendency of the molecules to occupy more space when they move at a faster rate. 5. *As* it was rather late, they decided to put off their work for the next day. 6. Technically, the process of obtaining oxygen is complicated *as* it requires one of the lowest temperatures used industrially –194.4°C. 7. *As* the hydrides of the alkali decompose in water, hydrogen is being released. 8. In the laboratory, hydrogen is made by the reaction of an acid such *as* sulphuric acid, H_2SO_4, with a metal such *as* zinc. 9. Mendeleyev is famous *as* the discoverer of the law of periodicity. 10. The molecules move faster *as* the temperature rises. 11. The explosion occured *as* the mixture was being heated.

Ex. 9. Translate the sentences into Russian.

1. Discussing the topic helped both of us to understand it better. 2. Working in the laboratory is the most important step in training chemists. 3. Professor N's participating in this conference attracted many other scientists. 4. His having made detailed notes at the lecture helped him to successfully pass the examination. 5. Our article being accepted in the *Journal of Analytical Chemistry* is a great honour to us. 6. There is no saying that the difference in temperature is too great. 7. Learning to work accurately is not an easy task. 8. Sometimes, preparing substances requires less skill than keeping them. 9. There is no denying that application of the quantum theory to chemistry stimulated its development. 10. Being very soft is characteristic of both calcium and sodium. 11. Lebedev's having prepared synthetic rubber paved the way to the synthesis of other materials. 12. Having examined the results led them to the conclusion that the structure of both compounds was alike. 13. Bohr's being awarded the Nobel prize was an international recognition of his great achievement. 14. Adding small quantites of other substances to alloys changes their properties, sometimes to a great extent. 15. Their coming to St. Petersburg was quite unexpected. 16. Investigating the weights and properties of elements led him to the discovery of his world-known law.

Ex. 10. Translate the sentences into English.

1. Закон Авогадро утверждает, что равные объемы различных газов содержат одинаковое количество молекул при одинаковых тем-

пературе и давлении независимо от состава. 2. При одинаковой температуре средние скорости движения молекул жидкости и газа одинаковы. 3. Нагревание тела, как правило, приводит к увеличению его объема. 4. Как у жидкости, так и у газа не все молекулы движутся с одинаковой скоростью при данной температуре. 5. Тенденция к испарению увеличивается, когда повышается температура. 6. Нельзя сказать, что все жидкости испаряются с одинаковой скоростью. 7. Точка кипения жидкости определяется температурой и давлением.

Ex. 11. Answer the following questions:

1. What does Avogadro's principle state? 2. In what way can the number of molecules per mole be determined? 3. What forces act between the molecules in a gas and in a liquid? 4. What affects the molecular motion? 5. What process is called evaporation? 6. What is the vapour pressure? 7. What does the boiling point of a liquid depend on?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

container, limit, crystalline, vibration, oscillation, crystal, phenomenon, sublimation, dioxide, camphor, sublime, coulomb, graphite, hexagonal, hexagon, associate, fix

Упр. 2. Определите значения выделенных слов по контексту.

1. Water turns into *ice* at 0°C. 2. The temperature at which a solid changes into a liquid is called its *melting point*. 3. *Repeat* the rule several times, then you will remember it. 4. H_2SO_4 is *apparently* a more complex compound than H_2S.

Слова к тексту:

shape — форма; **bound** — ограничивать; **dihedral** — образованный двумя плоскостями, гранями; **confine** — ограничивать; **dry** — сухой; **tie** — связывать

Text 17 B

Прочтите текст про себя (контрольное время чтения — 4 минуты).

Molecules in Solids

Having their own shape is a characteristic feature of solids since they have their own shape rather than that of the container (as for liquids and gases) and generally do not flow, the extent of molecular motion in a solid is even more limited than that in a liquid. True solids are crystalline, bounded by plane surfaces that meet in a definite dihedral angle, and have a characteristic melting point. The molecules in a solid have the same temperature, and if they are molecules of the same

substance, they are moving at the same average velocity, the motion of molecules in a solid must be confined, and, probably, it is a vibration or oscillation about a fixed point.

Crystals composed of molecules may evaporate in a manner similar to that of liquids. This phenomenon is called sublimation, and it may be noticed in solid carbon dioxide (dry ice), paradichlorobenzene, camphor, and many odorous solids. Non-molecular solids show little tendency to sublime. The Van der Waals force between the particles in molecular solids is, apparently, less in general than the coulomb forces between ions in non-molecular solids. As with liquids, solids vary greatly in their tendency to sublime, and the rate of sublimation varies with the temperature and inversely with the pressure. In some solids the crystal is composed of molecules in a pattern that repeats.

Упр. 3. Передайте основное содержание текста в нескольких предложениях.

Упр. 4. Составьте план текста.

Упр. 5. Прочтите предложения и скажите, соответствуют ли они содержанию текста. Если нет, исправьте их.

1. Liquids and gases usually have the form of their container. 2. Characteristic feature of solids is that they have their own form. 3. Crystalline solids cannot evaporate like liquids. 4. Sublimation is the evaporation of solids. 5. The rate of sublimation increases with the rise of the temperature and the pressure. 6. Planar structure of the carbon atoms in graphite makes its properties different from those of a diamond.

Упр. 6. Найдите в тексте и переведите на русский язык предложения, в которых говорится о движении молекул внутри вещества.

Section III

Ex. 1. Answer the questions, using the verb *make*.

1. When are you going to make calculations? 2. Who advised you to make this approach to the problem? 3. Have you finished making your measurements? 4. Do you make many mistakes in your English? 5. Don't you remember when Mendeleyev made his greatest discovery? 6. I think he won't make use of this law and what about you? 7. His lecture made a deep impression on me, and what about you? 8. How long did it take you to make your experiment?

Ex. 2. Translate the sentences into English.

1. Я думаю, необходимо еще раз провести расчеты. 2. Она всегда делает ошибки в чтении. 3. Наш лектор — большой ученый, он сделал важное открытие в физической химии. 4. Сначала вам надо изучить литературу по этому вопросу. 5. Никто не пользуется этим при-

бором сейчас, вы можете выполнить свои измерения. 6. Она внесла предложение поехать за город вместе. 7. Он произвел на нас очень хорошее впечатление.

Ex. 3. Make up short dialogues according to the model.

Model: — *A request.*
— *An answer.* (+, –)

Example:
— Give me your pen, please.
— Here you are. (Sorry, but I'm writing just now.)

Ex. 4. Give detailed answers to the following questions:

1. What is the essence of Avogadro's principle? 2. In what way can Avogadro's principle be used? 3. What do you know about the molecular motion? 4. What is the principal difference between gases, liquids and solids? 5. What is the difference in properties between crystalline and non-crystalline solids?

Ex. 5. Discuss the following topics:

1. The Characteristic Features of Gases, Liquids and Solids.
2. The Difference of the Molecular Motion in Various States of a Substance.
3. The Influence of the Temperature and the Pressure on the State of a Substance.

WHAT IS IT?

A compound of oxygen and another element (metallic or non-metallic).

Lesson 18

ГРАММАТИКА: Придаточное предложение в функции подлежащего.

Section I

Ex. 1. Practise your pronunciation.

a) iodine ['aɪədi:n], equilibrium [ˌi:kwɪ'lɪbrɪəm], fluidity [flʊ'ɪdɪtɪ], viewpoint ['vju:pɔɪnt], process ['prəʊses], agitate ['ædʒɪteɪt], vigorously ['vɪgərəslɪ], agitation [ˌædʒɪ'teɪʃən], thermal ['θɜ:məl], finally ['faɪnəlɪ], cause [kɔ:z], relative ['relətɪv], regular ['regjʊlə], arrangement [ə'reɪndʒmənt], instead [ɪn'sted], regularity [ˌregjʊ'lærɪtɪ]

b) 'liquid\iodine, and the\liquid, are in equi\librium, the 'nature of a \liquid, to 'stay 'close to\gether, the 'grouping of \molecules

c) 'As a 'crystal is/heated, | its 'molecules are in'creasingly agi\tated.

Ex. 2. Pay attention to the structure of the following words. Translate them into Russian:

a) somebody, someone, something, somewhere, somehow, somewhat, sometime, sometimes

b) important, pleasant, abundant, resistant, brilliant, disinfectant, lubricant, significant

c) freedom, kingdom, wisdom

Ex. 3. Define the meanings of the word *point* in the following sentences:

1. *Point* A on the graph corresponds to the boiling *point* of a solution. 2. The reaction goes to completion when the temperature is kept in the range of 25–30°C, this is a particularly important *point*. 3. At this *point* he stopped for a minute and then continued his explanation. 4. There are different *points* of view concerning the hypothesis. 5. The melting *point* of crystalline iodine is 114°C. 6. The process of melting can be described from the molecular *viewpoint*. 7. Up to this *point* everything was all right, but then something happened and the process became unstable. 8. It must be *pointed* out that only a crystal is characterized by regular arrangement of atoms and molecules. 9. It is a very interesting *point*, we shall discuss it later.

Ex. 4. Find the predicate and the subject in the following sentences:

1. That the properties of liquid iodine and solid iodine are different is quite obvious. 2. That the density of a liquid is less than that of a corresponding crystal can be easily explained. 3. How we are to make measurements will be clear from the instruction. 4. Whether high pressure is necessary is to be known from the article.

Text 18 A

The Nature of a Liquid

When iodine crystals are heated to 114°C, they melt forming liquid iodine. The temperature at which the crystals and the liquid are in equilibrium — that is, at which crystals have no tendency to melt or the liquid has no tendency to freeze — is called the *melting point* of the crystals, and the freezing point of the liquid. This temperature is 114°C for iodine.

Liquid iodine differs from solid iodine (crystals) mainly in its fluidity. Like the solid, and unlike the gas, it has a definite volume (1 g occupies about 0.2 cm^3), but it does not have a definite shape: instead, it fits itself to the shape of the bottom part of its container.

From the molecular viewpoint the process of melting can be described in the following way. As a crystal is heated, its molecules are increasingly agitated, and move about more and more vigorously, but at lower temperature, this thermal agitation does not carry any one molecule any significant distance away from the position fixed for it by the arrangement of its neighbours in the crystal. At the melting point the agitation finally

becomes so great that it causes the molecules to slip by one another and to change somewhat their location relative to one another. They continue to stay close together, but do not continue to retain a regular fixed arrangement. Instead, the grouping of molecules around a given molecule changes continually, sometimes being much like the close packing of the crystal, in which each iodine molecule has twelve near neighbours, and sometimes considerably different, the molecule has only ten or nine or eight near neighbours. Thus, a liquid, like a crystal, is a condensed phase, as contrasted with a gas, the molecules being piled rather closely together; but whereas a crystal is characterized by regularity of atomic or molecular arrangement, a liquid is characterized by randomness of structure. The randomness of structure is usually the reason why the density of a liquid is somewhat less than that of the corresponding crystal.

Words and Word-Combinations to Be Memorized

away, bottom, characterize, considerably, container, contrast, differ from, differ in, distance, finally, fit, fix, freeze, increasingly, instead, mainly, melt, melting point, phase point, melting, random, regular, relative, shape, significant, sometimes, somewhat, stay, that is, thermal, viewpoint

Ex. 5. Give the Russian equivalents for the following:

be in equilibrium, the tendency for crystals to melt, freeze the liquid, differ in properties, unlike the liquid, have a definite volume, instead, fit itself to the shape of, in the following way, carry away, change somewhat, stay close together, the close packing of the crystal, considerably different, a random structure, the density of a liquid

Ex. 6. Give the English equivalents for the following:

нагреть до, точка плавления вещества, отличаться от, иметь определенную форму сосуда, с точки зрения, изменить местоположение, группировка молекул вокруг, ближний сосед, плотная упаковка, характеризоваться чем-л., произвольное расположение молекул, несколько меньше, каждая молекула йода, относительно друг друга, отличаться чем-л., в отличие от газа

Ex. 7. Fill in the blanks with prepositons where necessary.

1. Crystals ... iodine melt when they are heated ... 114°C. 2. Liquid iodine differs ... solid iodine ... its fluidity. 3. Usually, liquid fits itself ... the shape ... the bottom space ... its container. 4. The process ... melting can be described ... the following way. 5. This process is interesing ... the molecular viewpoint. 6. Regularity ... atomic or molecular arrangement is characteristic ... a crystal. 7. A liquid is characterized ... randomness ... structure. 8. A solid occupies ... a definite volume.

Ex. 8. Translate the sentences into Russian, paying attention to different functions of the words ending in *-ing*.

1. Crystals melt, *forming* liquid iodine. 2. The temperature at which the crystals and the liquid are in equilibrium is called the *melting* point. 3. *Freezing* of a liquid is very *interesting* to observe. 4. *Heating* must be done in the *following* way. 5. The *grouping* of molecules around a given molecule changes by *raising* the temperature. 6. What are you *going* to do now? 7. Attempts are *being* made to synthesize new elements in laboratory.

Ex. 9. Translate the sentences into Russian.

1. Who is the discoverer of the periodic law is well known not only to specialists but practically to everybody. 2. That solid, liquid and gas are the three main states of a substance is a matter of common knowledge. 3. Whether these substances will react depends on the conditions of the reaction. 4. Whether a solution is acidic or not may be easily shown using litmus paper. 5. That a particular substance contains one element or another may be determined by qualitative analysis. 6. That the vapour pressure of a crystal depends on its size is well illustrated by many experiments. 7. Whether water is a compound or not may be shown by the reaction between water and some metals. 8. What ancient scientists thought was based on what they could observe around them. 9. That the alchemical period was very important in the history of chemistry is unquestionable. 10. That chain molecules can be many thousands of atoms in length affects the behaviour of these substances. 11. What number of protons is there in the nucleus of the element is known from its atomic number. 12. That water will dissolve a great number of different substances is an interesting fact. 13. That at the early stages of its development chemistry was mostly descriptive in character was quite natural. 14. Who the discoverer of nitrogen was is well known, it was isolated by Rutherford. 15. That students of chemistry should be able to write chemical equations readily and accurately is highly important. 16. That it was A. M. Butlerov who introduced the term "chemical structure" should not be forgotten. 17. That melting is a physical process must be quite clear to the student of chemistry. 18. Whether the hydrogen bond will be broken depends on the amount of energy. 19. Who will examine us in general chemistry is not known yet. 20. That the aim of science is to explain things is a popular belief. 21. When the process started was not registered by the instrument. 22. What pressure should be applied should be decided before the experiment.

Ex. 10. Translate the sentences into English.

1. Как происходит переход из одного физического состояния в другое, должно быть хорошо понятно каждому студенту. 2. Каждое вещество имеет свою собственную точку плавления при одинаковом давлении. 3. Точка плавления твердого вещества — это в то же время и точка замерзания жидкости. 4. Известно, что жидкость принимает

форму сосуда, в котором она содержится, но ее объем не зависит от объема сосуда. 5. В отличие от газа, у кристаллов и жидкостей молекулы располагаются довольно близко друг к другу. 6. То что структура является одной из важнейших характеристик состояния вещества, необходимо помнить всегда. 7. Кристаллы имеют упорядоченную структуру, а структура жидкости произвольна, поэтому плотность жидкости несколько меньше, чем у соответствующего кристалла.

Ex. 11. Answer the following questions:

1. What temperature is called the melting point? 2. What is the difference between liquid and crystalline iodine? 3. In what way is it possible to explain the change from the solid to the liquid? 4. What is the principal difference between solid and liquid from the structural viewpoint? 5. What does the molecular motion depend on?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

attractive, motion, total, diameter, extremely, distance, characteristic, operate, gram, atmosphere, temperature, ordinary

Упр. 2. Определите значения выделенных слов по контексту.

1. How many *times* have you been to Moscow? 2. The *specimen* was analysed and it became clear that it contains copper. 3. What *size* are your boots? 4. On the one hand, the process is rather simple, *on the other hand*, there is some difficulty because the temperature must be very high.

Слова к тексту:

negligibly — ничтожно; **apart** — отдельно, в стороны друг от друга; **accordingly** — соответственно

Text 18 B

Прочтите текст про себя (контрольное время чтения — 3 минуты).

The Nature of a Gas

That the molecules of a gas are not held together, but are moving freely in a volume rather large compared with the volumes of the molecules themselves is the characteristic feature of a gas. The Van der Waals attractive forces between the molecules still operate whenever two molecules come close together, but usually these forces are negligibly small because the molecules are far apart. Because of this freedom of molecular motion, a specimen of a gas does not have either definite shape or definite size. A gas shapes itself to its container.

Gases at ordinary pressure are very dilute: the molecules themselves constitute only about one-thousandth of the total volume of the gas, the

rest being empty space. Thus, 1 g of solid iodine has a volume of about 0.2 cm^3 (its density is 4.93 g/cm^3), whereas 1 g of iodine gas at 1-atm pressure and at the temperature of 184°C (its boiling point) has a volume of 148 cm^3, over 700 times greater. The volume of all the molecules in a gas at ordinary pressure is accordingly small compared with the volume of the gas itself. On the other hand, the diameter of a gas molecule is not extremely small compared with the distance between molecules; in a gas at room temperature and 1-atm pressure the average distance from a molecule to its nearest neighbours is about ten times its molecular diameter.

Упр. 3. Передайте основное содержание текста в нескольких предложениях.

Упр. 4. Составьте план текста.

Упр. 5. Прочтите предложения и скажите, соответствуют ли они содержанию текста. Если нет, исправьте их.

1. Molecules of a gas move freely in a volume of its container. 2. The Van der Waals forces don't act between the molecules of a gas. 3. The molecules of a gas are rather close together at ordinary pressure. 4. The volume occupied by a gas is considerably greater than the volume of a solid of the same element. 5. The distance between the molecules of a gas at 1-atm pressure is greater than the diameter of the molecule itself. 6. The temperature has no influence on the gas volume.

Упр. 6. Найдите в тексте и переведите на русский язык предложения в которых содержится описание самого отличительного свойства газа.

Section III

Ex. 1. Respond to the following statements using the expressions: *that's right*; *exactly so*; *you are mistaken*; *on the contrary*; *I wouldn't say so.*

1. The nature of a gas is quite similar to the nature of a liquid. 2. History is his unfavourite subject. 3. Nick doesn't like to make experiments. 4. I think theoretical physics is much more interesting than practical physics. 5. In my opinion, Professor N is not a good lecturer. 6. There is no need going to the library, you may find everything in this textbook. 7. You should have finished your measurements first and then made calculations.

Ex. 2. Translate the sentences into English.

1. Я думаю, для твоего опыта эта статья не нужна. — Ты ошибаешься, как раз здесь дается описание этого опыта. 2. Тексты о природе жидкости и газа очень похожи. — Да, правильно, они оба описывают их природу с молекулярной точки зрения. 3. Кажется, 1 г твердого йода занимает объем около 0,2 $см^3$, да? — Точно так. 4. Катя не пойдет с нами? — Наоборот, это была как раз ее идея пойти на концерт.

5. По-моему, Петр — ненадежный человек. — Я бы этого не сказал, он всегда делает то, что говорит. 6. Тебе некогда будет читать завтра. — Наоборот, завтра у меня нет занятий.

Ex. 3. Make up short dialogues according to the model.

Model: — *A statement.*
— *A question.*
— *An answer.*

Example:

— I like reading very much.
— What do you like?
— Reading.

Ex. 4. Give detailed answers to the following questions:

1. What happens to a crystalline substance when it is heated? 2. What is the melting point of a substance? 3. What are the characteristic features of a liquid? 4. What are the characteristic features of a gas? 5. What does the physical state of a substance depend on?

Ex. 5. Discuss the following topics:

1. Factors that Influence the Physical State of a Substance.
2. Solids, Liquids and Gases from the Molecular Point of View.
3. An Example of Transformation of the Same Substance into Different States.

WHAT IS IT?

The measure of the degrees of hotness or coldness of a substance or a body.

Part Three

THE OBJECT

Lesson 19

ГРАММАТИКА: Место дополнения в предложении. Существительное и местоимение в функции дополнения.

Section I

Ex. 1. Practise your pronunciation.

a) originally [ə'rɪdʒənəlɪ], stereochemistry [ˌsterɪə'kemɪstrɪ], final ['faɪnəl], postulate ['pɒstjʊlɪt], draw [drɔ:], concise [kən'saɪs], qualitative ['kwɒlɪtətɪv], numerous ['nju:mərəs], electronic [ɪlek'trɒnɪk], culminate ['kʌlmɪneɪt], completion [kəm'pli:ʃən], emphasize ['emfəsaɪz], clarify ['klærɪfaɪ], isomer ['aɪsəmə]

b) the◡'structure◡of◟molecules, compo'sition◡of◡a◟substance, the◡'nature◡of◡the◡re◟action, the◡'theory◡of◟valence, 'after◡the◡dis◟covery, an◡elec'tronic◟theory, 'these◡i◟deas, all◡of◡'these◟students

c) The 'nature of the 'bond | was com'pletely un◟known.

Ex. 2. Pay attention to the structure of the following words. Translate them into Russian.

a) stereotype, stereochemistry, stereophonic, stereoscope, stereometry
b) dihedral, trihedral, tetrahedral, pentahedral, octahedral
c) neighbourhood, childhood, boyhood, manhood

Ex. 3. Define the meanings of the word *part* in the following sentences:

1. A theory usually involves some idea about the nature of some *part* of the Universe. 2. One of the most valuable *parts* of the chemical theory is the periodic law. 3. Hard alloys are applied to the surfaces of metal *parts*, increasing the life of the *parts* many times. 4. The substances taking *part* in the reaction should be pure. 5. *Partly*, you can find the necessary information in this monograph. 6. V. Tikhonov played the *part* of Bolkonsky

in the *War and Peace*. 7. They *parted* at 6 o'clock. 8. The firm was only a *partial* success. 9. Under certain conditions, hydrogen atoms in this compound may be in *part* substituted by sulphur.

Ex. 4. Find the predicate, the subject and the object in the following sentences:

1. In the nineteenth century the valence bond was represented by a line drawn between the symbols of two chemical elements. 2. Lewis' paper written in 1916 is considered to be the basis of the modern electronic theory of valence. 3. These ideas were further developed by many investigators.

Text 19 A

The Study of the Structure of Molecules

The study of the structure of molecules was originally carried on by chemists using methods of investigation that were essentially chemical in nature, relating to the chemical composition of a substance, the existence of isomers, the nature of the chemical reactions in which a substance takes part and so on. From the consideration of facts of this kind Frankland, Kekulè, Couper and Butlerov were led a century ago to formulate the theory of valence and to write the first structural formulas for molecules, van't Hoff and le Bel were led to bring classical organic stereochemistry into its final form by their brilliant postulate of the tetrahedral orientation of the four-valence bonds of the carbon atom, and Werner was led to his development of the theory of the stereochemistry of complex inorganic substances.

In the nineteenth century the valence bond was represented by a line drawn between the symbols of two chemical elements, which expressed in a concise way many chemical facts, but which had only qualitative significance with regard to molecular structure. The nature of the bond was completely unknown. After the discovery of the electron, numerous attempts were made to develop an electronic theory of the chemical bond. These culminated in the work of Lewis, who in his 1916 paper, which forms the basis of the modern electronic theory of valence, discussed not only the formation of ions by the completion of stable shells of electrons but also the formation of a chemical bond, now called the covalent bond, by the sharing of the two electrons between two atoms. Lewis further emphasized the importance of the phenomena of the pairing of unshared as well as of shared electrons and of the stability of the group of eight electrons (shared or unshared) about the lighter atoms. These ideas were then further developed by many investigators; the work of Langmuir was especially valuable in showing the great extent to which the facts of chemistry could be coordinated and clarified by the application of the new ideas. Many of the features of the detailed theory that is discussed were suggested in the papers of Langmuir and others written in the decade

following 1916, or in the book *Valence and Structure of Atoms and Molecules* written by Lewis in 1923.

All of these early studies, however, contained, in addition to suggestion that have since been incorporated into the present theory, many others that have been discarded.

Words and Word-Combinations to Be Memorized

complex, consideration, coordinate, decade, discard, discuss, draw, especially, essentially, formation, incorporate, lead to, line, numerous, originally, paper, phenomenon, with regard to, relate, and so on, stability, stable, structural, take part, valence, valuable

Ex. 5. Give the Russian equivalents for the following:

carry on the study, essentially chemical in nature, take part in a reaction, from the consideration of facts, formulate the theory of valence, structural formulas for molecules, final form, tetrahedral orientation of the bonds, represent the bond by a line, draw a line between, have qualitative significance, with regard to molecular structure, form the basis of a theory, share the electrons between the atoms, the features of the detailed theory, be incorporated into

Ex. 6. Give the English equivalents for the following:

изучение структуры молекул, методы исследования, первоначально, химический состав, существование изомеров, природа химической реакции, и так далее, принять участие в реакции, такого рода факты, столетие тому назад, написать структурную формулу, четыре валентные связи атома углерода, теория стереохимии, провести линию, многочисленные попытки, сделать попытку, развить теорию, электронная теория валентности, образование химической связи, ковалентная связь, поделить электроны между чем-л., подчеркнуть значение чего-л., применение новых идей, предложить теорию, кроме, первые исследования

Ex. 7. Fill in the blanks with prepositions where necessary.

1. Early chemists carried ... the study ... the structure ... molecules ... the methods that were essentially chemical ... nature. 2. The first structural formulas ... molecules were written ... more than a century ago. 3. ... the 19th century the valence bond was represented ... a line ... the symbols ... two chemical elements. 4. The nature ... the bond was completely unknown. 5. ... the discovery ... the electron attempts were made to develop an electronic theory ... the chemical bond. 6. ... 1916 Lewis formed ... the basis ... the modern electronic theory ... valence. 7. Early studies contained ... some suggestions that were discarded later.

Ex. 8. Translate the sentences into Russian, paying attention to different functions of the word *regard*.

1. At the beginning of the 19th century, atoms were *regarded* as the smallest constituent particles of matter. 2. Equal volumes of gases are stated to contain the same number of molecules at the same temperature and pressure, *regardless* of composition. 3. Unfortunately, it's not always that the young have great *regard* to their parents. 4. Particular attention must be paid to the chapter *regarding* the conditions of synthesis. 5. Many chemical facts were described which had only qualitative significance with *regard* to molecular structure. 6. The work of Lewis was most important as *regards* the development of the electronic theory of valence.

Ex. 9. Translate the sentences into Russian.

a) 1. These results are not in agreement with the theory. 2. They did their work in time. 3. Register the readings and then begin the calculations. 4. Put the burner on the table. 5. The discovery of the electron stimulated the development of an electronic theory. 6. The information was given to a numerous audience. 7. The rate of the reaction often depends on the temperature. 8. The heating resulted in the explosion. 9. Give this instruction to the students. 10. Give the students this instruction. 11. Lowering the temperature of a liquid lessens the kinetic energy. 12. Hydrogen has 3 isotopes. 13. The study of the structure of molecules has been carried on by scientists since early times.

b) 1. Have you seen him? 2. Did you speak to her yesterday? 3. I don't know anything about the author of this monograph. Do you know anything about him? 4. It is a very good apparatus, everybody likes to work with it. 5. The bottle with H_2SO_4 is on that shelf, bring it, please. 6. The temperature must be 25°C, don't forget it. 7. They think it necessary to attend all the seminars. 8. The teacher made it clear that the examination will be difficult to pass. 9. Avogadro's principle let one calculate the number of molecules per gram mole of a gas. 10. Chemistry helps one to understand other fields of science better. 11. The properties of HCl make it a useful laboratory reagent. 12. Consideration of all the facts enabled us to draw a very important conclusion. 13. They don't think it possible to work with this substance, it is not pure enough.

Ex. 10. Translate the sentences into English.

1. Проблема структуры молекулы давно интересовала химиков. 2. Структурная формула — это формула, которая показывает, как сгруппированы элементы и как распределяются связи в молекуле. 3. Бутлеров был первым из русских ученых, кто написал структурную формулу. 4. В XIX столетии валентную связь представляли линией, которую проводили между символами двух химических элементов. 5. Природа связей тогда была совершенно неизвестна. 6. При изучении структуры молекул было открыто существование изомерии.

7. Изомеры — это соединения, которые имеют одну и ту же молекулярную формулу, но разные структуры.

Ex. 11. Answer the following questions:

1. What methods were used in the first investigations of the structure of molecules? 2. What do you know about isomers? 3. Who formulated the theory of valence? 4. What is particularly interesting as regards the valence bonds of the carbon atom? 5. In what way was the valence bond represented? 6. How did the discovery of the electron affect the development of an electronic theory? 7. What do you know about the work of Lewis?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

diffraction, magnetic, dipole, moment, interpretation, resonance, entropy, information, configuration, quantum, mechanics, anticipate, discussion

Упр. 2. Определите значения выделенных слов по контексту.

1. Properties of an element *are due to* the composition and structure of its atom. 2. Our laboratory is *provided* with all the necessary chemicals and devices. 3. It is not always easy to give a *complete* characteristic of a compound. 4. *X-rays* are sometimes called Röntgen rays. 5. In a molecular spectrum a series of rather broad *bands* is formed, that is why it is called *band* spectrum. 6. It is necessary to take into *account* the unusual properties of the compound.

Слова к тексту:

with respect to — в отношении чего-л.; **wave** — волна; **nuclear** — ядерный; **refinement** — усовершенствование; **disperse** — рассеивать; **veil** — покров, завеса; **mystery** — тайна; **shroud** — окутывать

Text 19 B

Прочтите текст про себя (контрольное время чтения — 3 минуты).

The Development of the Theory of Valence

Modern structural chemistry differs from classical structural chemistry with respect to the detailed picture of molecules and crystals that it presents. By various physical methods, including the study of the structure of crystals by the diffraction of X-rays and of gas molecules by the diffraction of electron waves, the measurement of electric and magnetic dipole moments, the interpretation of band spectra, line spectra, microwave spectra, and nuclear magnetic resonance spectra, and the determination of entropy values, a great amount of information has been obtained about the atomic configurations of molecules and crystals and even their electronic

structures; a discussion of valence and the chemical bond now must take into account this information as well as the facts of chemistry.

The refinment of the electronic theory of valence into its present form has been due almost entirely to the development of the theory of quantum mechanics, which has not only provided a method for the calculation of the properties of simple molecules, leading to the complete elucidation of the phenomena involved in the formulation of a covalent bond between two atoms and dispersing the veil of mystery that has shrouded the bond during the decades since its existence was first assumed, but has also introduced into chemical theory a new concept, that of resonance, which, if not entirely unanticipated in its applications to chemistry, nevertheless, has not before been clearly recognized and understood.

Упр. 3. Передайте основное содержание текста в нескольких предложениях.

Упр. 4. Составьте план текста.

Упр. 5. Прочтите предложения и скажите, соответствуют ли они содержанию текста. Если нет, исправьте их.

1. Structural chemistry hasn't changed since the 19th century. 2. The pictures of molecules presented by modern chemistry and classical structural chemistry are not the same. 3. Electronic structures are investigated only by chemical methods. 4. The development of the theory of quantum mechanics affected the refinement of the electronic theory. 5. A concept of resonance was introduced in terms of the theory of quantum mechanics. 6. Application of quantum mechanics enabled scientists to develop a method for the calculation of the properties of simple molecules.

Упр. 6. Найдите в тексте описание различий между современной структурной химией и классической и переведите эти предложения на русский язык.

Section III

Ex. 1. Respond to the following, using the expressions: *to do smth* (*to work, to study, to make observations, etc.*) *under smb* (*Prof. N, Dr. A, etc.*).

1. The laboratory is now an important scientific centre, who is the head of it? 2. He says he has a very good scientific adviser, under whom does he study? 3. He has written a very good article, whom did he consult? 4. I know that he does physics at Moscow University, who is his supervisor? 5. You should consult your teacher before making observations, who is your teacher? 6. This book is rather difficult but very useful for your work, who advised you to read it? 7. Your brother obtained his degree last year, who was his scientific adviser?

Ex. 2. Translate the sentences into English.

1. Я выполнил эту работу под руководством профессора N. 2. Студенческое научное общество работает под руководством доктора N. 3. Группа, которой руководит доктор N, недавно опубликовала очень интересную статью о своих последних исследованиях. 4. Под чьим руководством вы проходите практику? 5. Мы занимаемся в лаборатории качественного анализа под руководством N. 6. Моя подруга выполняет свою курсовую работу под руководством N, ей очень нравится работать с ним. 7. Я не знаю, под чьим руководством мы будем работать в следующем учебном году.

Ex. 3. Make up short dialogues according to the model.

Model: — *A question.*
— *An answer.* (+, –)
— *A request.*

Example:

— Are you going to the dean's office today?
— I think so.
— Could you give my application to the secretary?

Ex. 4. Give detailed answers to the following questions:

1. What can you say about the early studies concerning the structure of molecules? 2. What important discoveries were made in the course of structural investigations? 3. In what way was the valence bond understood in the 19th century? 4. What investigations laid the foundation of the modern electronic theory? 5. What methods were used to study the structure of molecules?

Ex. 5. Discuss the following topics:

1. The Contribution of the Great Scientists of the Nineteenth Century to the Structural Theory.
2. The Methods Used in Structural Investigations.
3. The Refinement of the Electronic Theory of Valence.

WHAT IS IT?

The combining power of an atom, equal to the number of hydrogen atoms which an atom will combine with or replace.

Lesson 20

ГРАММАТИКА: Инфинитив и инфинитивный оборот в функции дополнения.

Section I

Ex. 1. Practise your pronunciation.

a) covalent [kəʊ'veɪlənt], distribute [dɪs'trɪbjʊt], electron [ɪ'lektrɒn], ethyl ['eθɪl], ['i:θaɪl] (*chem.*), dimethyl [daɪ'meθɪl], [-mi:θaɪl] (*chem.*), ether ['i:θə],

alcohol ['ælkəhɒl], hydroxyl [haɪ'drɒksɪl], California [ˌkælə'fɔ:nɪə], through [θru:], electronic [ɪlek'trɒnɪk]

b) the ˌelec'tronic ˌ'structure ˌof ˎmolecules, the ˌ'number ˌof ˌ'valence eˎlectrons, un'shared ˌe'lectron ˎpairs, in ˌ'such ˌa ˎway, in ˌits ˌ'outer ˌˎshell, for ˌ'other ˎmolecules, for ˌ'over ˌa ˌ'hundred ˎyears, at ˌthe ˌbe'ginning ˌof ˌthe ˎcentury

c) It is the co'valent/bond | that is ˌrepre'sented by a 'dash in the 'valence-bond ˎformulas.

Ex. 2. Pay attention to the structure of the following words. Translate them into Russian.

a) hydrogen, hydroxyl, hydrate, hydride, hydrocarbon, hydrolysis, hydrolyze, hydroxide, hydrochloric acid

b) a chemical, a proposal, a general, a crystal, a credential, a liberal, a criminal

c) sulphide, halide, fluoride, hydride, bromide, oxide, selenide, nitride, iodide, chloride

Ex. 3. Define the meanings of the word *way* in the following sentences:

1. In what *way* is hydrogen produced? 2. The teacher didn't like the *way* the student was handling the instrument. 3. The situation is rather difficult, I don't see any *way* out. 4. The compound obtained in this *way* is usually pure enough. 5. In some *way* or other, the work must be finished today. 6. It is a long *way* from here to his home. 7. On his *way* home he met N. 8. By the *way*, what is the symbol of manganese? 9. The investigation that is under *way* in their laboratory is of particular interest.

Ex. 4. Find the predicate, the subject and the object in the following sentences:

1. The chemical properties show ethyl alcohol to contain one hydrogen atom attached to an oxygen atom. 2. Before 1900 many chemists believed water to be the only solvent in which typical ionic reactions could be carried out. 3. Dalton assumed atoms to be indivisible particles of the elementary substance.

Text 20 A

The Structure of Covalent Compounds

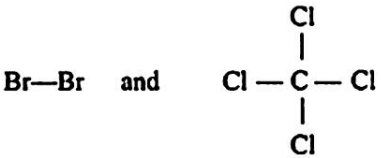
The electronic structure of molecules of covalent compounds involving the principal groups of the periodic table can usually be written by counting the number of valence electrons in the molecule and then distributing the valence electrons as unshared electron pairs and shared electron pairs in such a way that each atom achieves an argonic structure.

For many molecules the covalence of each atom is equal to the number of unpaired electrons in its outer shell, and is, thus, simply related to the position of the element in the periodic table. For other molecules and ions the covalence of the atoms is less simply related to the periodic table.

It is often necessary to have some experimental information about the way in which the atoms are bonded together. Thus, there are two compounds with the composition C_2H_6O: ethyl alcohol and dimethyl ether. The chemical properties of these two substances show one of them, ethyl alcohol, to contain one hydrogen atom attached to an oxygen atom, whereas dimethyl ether doesn't contain such a hydroxyl group.

The atoms of most molecules are held tightly together by a very important sort of bond, the shared-electron-pair bond or the covalent bond. This bond is so important, so nearly universally present in substance that Professor Gilbert Newton Lewis of the University of California (1876–1946), who discovered its electronic structure, called it the chemical bond.

It is the covalent bond that is represented by a dash in the valence-bond formulas, such as



that have been written by chemists for over a hundred years.

Modern chemistry has been greatly simplified through the development of the theory of the covalent bond. It is now easier to understand and to remember chemical facts, by connecting them with our knowledge of the nature of the chemical bond and the electronic structure of molecules, than was possible at the beginning of the century.

Words and Word-Combinations to Be Memorized

achieve, argon, such a, connect, ether, ethyl, experimental, greatly, information, nearly, professor, simplify, sort, universally, university, covalent, in such a way, in this way

Ex. 5. Give the Russian equivalents for the following:

the principal groups of the periodic table, count the number of valence electrons, distribute the electrons, unshared electron pairs, in the outer shell, be related to, it is often necessary to, be bonded together, attach one atom to another, a hydroxyl group, be held together, represent the bond by a dash, over a hundred years, it is now easier to understand, the theory of the covalent bond

Ex. 6. Give the English equivalents for the following:

ковалентное соединение, поделенная электронная пара, таким образом, быть равным чему-л., положение элемента в периодической таблице, этиловый спирт, присоединить к, ковалентная связь, Калифорнийский университет, Санкт-Петербургский университет, совре-

менная химия, упростить что-л., запомнить факты, природа химической связи, электронная структура молекулы, быть возможным, в начале столетия

Ex. 7. Fill in the blanks with prepositions where necessary.

1. ... many molecules the covalence ... each ... atom is equal ... the number ... unpaired electrons ... its outer level. 2. There are some other molecules ... which the covalence ... the atoms is not directly related ... the periodic table. 3. ... ethyl alcohol one hydrogen atom is attached ... an oxygen atom. 4. Dimethyl ether does not contain ... a hydroxyl group. 5. The atoms ... most molecules are held together ... a covalent bond. 6. Modern chemistry was greatly simplified ... the development ... the theory ... the covalent bond.

Ex. 8. Translate the sentences into Russian, paying attention to different functions of *one*.

1. There is some difference as regards solubility of gases in liquids, of two gases the *one* that is more readily liquefied is the more soluble. 2. The transition elements are the *ones* that have their inner shells partly filled. 3. Ethyl alcohol contains *one* hydrogen atom attached to an oxygen atom. 4. Now *one* can understand chemical phenomena better by connecting chemical facts with the nature of the chemical bond. 5. Reliable experimental data enable *one* to draw proper conclusions. 6. This approach is quite similar to the *one* just described. 7. The procedure is a simple *one*. 8. *One* finds the reason for this similarity in the periodic table. 9. It takes *one* much time to make all the calculations without a computer. 10. It is *one* of the simplest methods and it is often recommended to the students.

Ex. 9. Translate the sentences into Russian.

1. Everybody considers him to be an expert in his field. 2. Mendeleyev believed some elements to be missing in his periodic table and he even predicted their properties. 3. The teacher expected us to finish the work at 5, but we couldn't solve the problem. 4. I suppose the paper to have been already typed. 5. They saw him pour the liquid into the test-tube and then heat the tube over the burner. 6. She heard somebody call her and went to the door. 7. We waited for the solution to boil. 8. I knew him to have passed the exam in mathematics successfully, that is why I asked him to help me. 9. We should expect the atomic weight of sulphur to be greater than that of oxygen. 10. The ancient scientists believed earth, water, air and fire to be elements. 11. Dalton thought a water molecule to consist of one hydrogen and one oxygen atom. 12. Certain conditions must be observed to make nitrogen react with other elements. 13. Sometimes, the presence of the catalyst causes the two elements to unite and form a compound. 14. Dr. N thought high stability of the compound to be due to the presence of an admixture ions. 15. Let's assume the volume of the gas to be equal to x. 16. He was made to stay in the

laboratory and finish cleaning. 17. Pressure causes gas to compress. 18. The obtained results led us to draw the following conclusion. 19. Under ordinary conditions it is not always easy to get some elements to combine with other elements. 20. They were forced to use an old apparatus because the new one was out of order. 21. Qualitative analysis enables the composition of a sample to be determined. 22. Mendeleyev's periodic table allows the suppositions about the atomic structure to be made. 23. Experiments sometimes permit some useful information about the chemical bond to be obtained.

Ex. 10. Translate the sentences into English.

1. Знание электронной структуры атомов позволяет определить характер связи. 2. Ковалентность каждого атома в молекуле может быть в большей или меньшей степени связана с его положением в периодической таблице. 3. Существуют соединения, имеющие одинаковый состав, но разную структуру. 4. Один из примеров таких соединений — это этиловый спирт и диметиловый эфир, оба они могут быть написаны одной и той же формулой — C_2H_6O. 5. В молекулах атомы удерживаются вместе посредством связей, одна из наиболее распространенных связей — ковалентная. 6. Эта связь очень интересна с точки зрения ее электронной структуры.

Ex. 11. Answer the following questions:

1. In what way is it possible to count the number of valence electrons in the molecule? 2. What rule helps us to determine the distribution of valence electrons in electron pairs? 3. What attracts the attention of the chemists as regards such compounds as ethyl alcohol and dimethyl ether? 4. What kind of bond is usually called a covalent bond? 5. What is the usual way of writing structural formulas of molecules?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

conduct, electricity, indication, orbital, spin, energy, control, configuration, stability, characteristic

Упр. 2. Определите значения выделенных слов по контексту.

1. We saw her on the opposite side of the street and *crossed* the street to meet her. 2. In terms of modern chemistry it is more correct to speak about the electronic *levels* than electronic shells. 3. The *main* duty of a student is to study.

Слова к тексту:

loose — высвобождать; **desire** — желать; **goal** — цель; **seek** — искать, стремиться; **in turn** — в свою очередь

Text 20 B

Прочтите текст про себя (контрольное время чтения — 3 минуты).

Covalence

Many compound substances do not have particularly high melting and boiling points, do not conduct electricity when they are molten, and, thus, give no indication of being ionic. The particles of such compounds are molecules. In these, any bond between two atoms is believed to be a pair of shared electrons, as it was suggested originally by the American chemist G. N. Lewis. The electrons of such a shared pair occupy a single orbital and spin in opposite directions. Atoms entering such unions are said to exibit covalence and the bonds thus formed are described as covalent.

When two or more atoms share electrons to form molecules, all the electrons of the several atoms involved* become common property and are distributed among energy levels and orbitals characteristic of the molecules. A simpler treatment than this method of molecular orbitals is that of atomic orbitals. By it, each atom in the molecule is treated as if it controlled all its own electrons except those shared with another atom. The shared electrons are treated as common to both.

The carbon atom has two electrons in its first main energy level and four in its second. To obtain a noble-gas configuration it would have to loose or gain 4 electrons. Since it can do neither, it approaches the desired goal as nearly as possible by sharing its 4 electrons with atoms that also seek greater stability and will, in turn, share some of their valence electrons with it.

Упр. 3. Передайте основное содержание текста в нескольких предложениях.

Упр. 4. Составьте план текста.

Упр. 5. Прочтите предложения и скажите, соответствуют ли они содержанию текста. Если нет, исправьте их.

1. Not all compound substances conduct electricity when they are molten. 2. Lewis studied the bond formed by a pair of shared electrons. 3. The bond is described as covalent if the electrons of a shared pair occupy a single orbital and spin in opposite directions. 4. The method of atomic orbitals is more complex than that of molecular orbitals. 5. The shared electrons are believed to belong to one of the two bounded atoms. 6. To obtain a noble-gas configuration the carbon atom has to loose 4 electrons.

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* the several atoms involved — несколько участвующих атомов

Упр. 6. Найдите в тексте описание того, как распределяются электроны при образовании связи с участием углеродного атома, и переведите этот отрывок на русский язык.

Section III

Ex. 1. Respond to the following using the verbs *to say, to speak, to tell, to talk*:

1. Do you speak German? 2. Can you speak louder? 3. He said, I was right, didn't he? 4. Don't say anything, if you are not sure. 5. Tell her that she should come at 10 o'clock, please. 6. He told me that there were too many mistakes in my paper. 7. They talked all the evening, but I didn't take part in their conversation. 8. You were talking to Dr. N when I met you, what did you tell him?

Ex. 2. Translate the sentences into English.

1. Наш преподаватель часто говорит, что мы мало читаем. 2. Он говорит нам, что надо читать новые журналы. 3. Скажите, почему вы не пришли вчера? 4. Они говорили о методе измерений, когда я подошел. 5. Говорите громче, пожалуйста. 6. Он не любит говорить о своих планах. 7. На каком иностранном языке вы говорите? 8. Скажите мне, когда закончите. 9. Он говорит, что этот материал очень труден. 10. Она сказала, что сегодня не готова отвечать.

Ex. 3. Make up short dialogues according to the model.

Model: — *A statement.*
— *A question.*
— *A statement.*

Example:

— *I haven't prepared my homework today.*
— *Haven't you traslated the text?*
— *I've only looked it through.*

Ex. 4. Give detailed answers to the following questions:

1. What electrons take part in forming bonds between atoms? 2. What kind of bonding is called a covalent bond? 3. What is the relationship between the activity of the molecule and its structure? 4. What do modern chemists think about the phenomenon of covalence?

Ex. 5. Discuss the following topics:

1. The Structure of Covalent Compounds.
2. The Kinds of Bonds Between the Atoms.
3. An Example of a Covalent Compound.

WHAT IS IT?

A way of holding component atoms together in a single molecule characterized by the sharing of electrons.

Lesson 21

ГРАММАТИКА: Причастный оборот в функции дополнения.

Section I

Ex. 1. Practise your pronunciation.

a) require [rɪ'kwaɪə], completion [kəm'pli:ʃən], extremely [ɪks'tri:mlɪ], neutralization [ˌnju:trəlaɪ'zeɪʃən], presumably [prɪ'zju:məblɪ], hydroxide [haɪ'drɒksaɪd], collision [kə'lɪʒən], precipitate (*n*) [prɪ'sɪpɪtət], precipitate [prɪ'sɪpɪteɪt] (*v*), appreciable [ə'pri:ʃəbl], circumstance ['sɜ:kəmstəns], irradiation [ɪˌreɪdɪ'eɪʃən], ultraviolet [ˌʌltrə'vaɪəlɪt], neutron ['nju:trɒn]

b) the ˈrate of a ˌre↘action, for its ˌcom↘pletion, the ˈnumber of col↘lisions, there is ˈlittle de↘lay, it is ˈnot un↘usual, with ˈvisible↘light

c) On the 'other/hand, | i'onic oxi'dation-re'duction re'actions | are 'sometimes 'very ↘slow.

Ex. 2. Pay attention to the structure of the following words, translate them into Russian:

a) ultraviolet, ultramodern, ultrashort, ultrasound, ultrasonic
b) twofold, threefold, fourfold, tenfold, manifold
c) ferric — ferrous, nitric — nitrous, sulphuric — sulphurous, stannic — stannous

Ex. 3. Define the meanings of the word *other* in the following sentences:

1. Chemists and *other* scientists use the word "theory" in two different senses. 2. The first meaning is "a hypothesis that has been verified"; the *other* meaning is "a systematic body of knowledge". 3. On the basis of the experimental results of Priestley, Scheele, and *others*, as well as some very fine experimental work of his own, Lavoisier established a new concept of combustion. 4. There are more compounds of hydrogen known than of any *other* element. 5. *Other* conditions being equal, the conclusion was made that it proceeds faster. 6. The silver-grey coating on its surface is characteristic of selenium, *another* variety of the element is red. 7. There are some reactions which proceed very quickly, on the *other* hand, there are *other* reactions which are extremely slow under the same conditions. 8. It is not easy for them to work together because they don't like each *other*. 9. The results that were obtained in this experiment are not reliable, that implies that we should try some *other* approach than we have just employed.

Ex. 4. Find the predicate, the subject and the object in the following sentences:

1. We could observe the solution changing colour with time. 2. Some catalysts accelerate reactions, others make them proceed slower. 3. It was interesting to watch Dr. N demonstrating his experiments.

Text 21 A

Factors Influencing the Rate of Reactions

Every chemical reaction requires some time for its completion, but some reactions are very fast and some are very slow. Reactions between ions in solution without change in oxidation state are usually extremely fast. An example is the neutralization of an acid by a base, which proceeds as fast as the solutions can be mixed. Presumably nearly every time a hydronium ion collides with a hydroxide ion reaction occurs, and the number of collisions is very great, so that there is little delay in the reaction. The formulation of a precipitate, such as that of silver chloride when a solution containing silver ion is mixed with a solution containing chloride ion, may require a few seconds, to permit the ions to diffuse together to form the crystalline grains of the precipitate:

$$Ag^{+}(aq) + Cl^{-}(aq) \rightarrow AgCl(c).$$

On the other hand, ionic oxidation-reduction reactions are sometimes very slow. An example is the oxidation of a stannous ion by a ferric ion:

$$2Fe^{3+} + Sn^{2+} \rightarrow 2Fe^{2+} + Sn^{4+}.$$

This reaction does not occur every time a stannous ion collides with one or two ferric ions. In order for a reaction to take place, the collision must be of such a nature that electrons can be transferred from one ion to another, and collisions that permit this electron transfer to occur may be rare.

An example of a reaction that is extremely slow at room temperature is that between hydrogen and oxygen:

$$2H_2 + O_2 \rightarrow 2H_2O.$$

A mixture of hydrogen and oxygen can be kept for years but we can observe no appreciable reaction taking place.

That is why it is not unusual to hear chemists speaking about the factors that determine the rate of a reaction. These are manifold. The rate depends not only upon the composition of the reacting substances, but also upon their physical form, the intimacy of their mixture, the temperature and pressure, the concentrations of the reactants, special physical circumstances such as irradiation with visible light, ultraviolet light, X-rays, neutrons, or other waves or particles, and the presence of other substances that affect the reaction but are not changed by it.

Words and Word-Combinations to Be Memorized

affect, appreciable, collide, collision, concentration, ferric, a few, on the other hand, influence, ion, ionic, neutralization, in order for, permit, proceed, reduction, take place, that is why, transfer, ultraviolet, unusual, visible, wave, X-ray

Ex. 5. Give the Russian equivalents for the following:

require time for, oxidation state, be extremely fast, nearly every time, collide with, form the precipitate, oxidation-reduction reactions, in order for a reaction to take place, transfer electrons, observe a reaction, the intimacy of mixture, irradiation with light, ultraviolet light, affect the reaction, hydronium ion

Ex. 6. Give the English equivalents for the following:

влиять на скорость реакции, без изменения окислительного состояния, нейтрализация кислоты основанием, смешивать растворы, число столкновений, так что, такой как, хлорид серебра, несколько секунд, с другой стороны, сталкиваться для того чтобы, при комнатной температуре, смесь водорода и кислорода, наблюдать, вот почему, зависеть от, видимый свет, рентгеновские лучи

Ex. 7. Fill in the blanks with prepositions where necessary.

1. One can give ... an example ... a reaction which may require ... a few seconds ... its completion. 2. ... the other hand, oxidation-reduction reactions are sometimes very slow. 3. An example ... a reaction that is extremely slow ... room temperature is that ... hydrogen and oxygen. 4. It is quite usual to hear chemists speaking ... the factors that influence ... the rate ... a reaction. 5. The reaction rate depends ... many factors. 6. Sometimes the presence ... other substances affects ... the reaction. 7. Every reaction takes different time ... its completion.

Ex. 8. Translate the sentences into Russian, paying attention to different functions of the word *order*.

1. St. Petersburg University was awarded the *Order* of Lenin in 1944 and the *Order* of the Red Banner of Labour in 1969. 2. In arranging his ideas for the book *Principles of Chemistry* Mendeleyev felt the need to bring to inorganic chemistry the same degree of *order* that was being achieved in organic chemistry. 3. We were *ordered* to start the work immediately. 4. In *order* for a reaction to take place, the collision between the ions must result in the transfer of electrons from one ion to another. 5. In *order* that the reaction might occur, the reactants should be heated. 6. We must measure all the parameters in *order* to summarize them in a table. 7. Crystalline compounds have their atoms arranged in a certain *order*.

Ex. 9. Translate the sentences into Russian.

1. The door was open and we could hear Prof. N giving his lecture. 2. Coming up to him for the second time I found his experiment finished. 3. We saw the powder darkening when it was exposed to light. 4. We shall have our papers checked and then we shall be permitted to do the experimental part. 5. We all heard her saying so. 6. We may treat the

electrons in the shared electron pair as belonging to both atoms. 7. We usually think of a substance as being in a certain physical state. 8. Solutions are often thought of as being liquids. 9. They watched the sugar crystals disappearing in water. 10. Lavoisier considered oxygen as being a constituent of all acids. 11. After Dalton we find the atomic theory developed rather than rejected. 12. The inertness of the noble gases is accounted for by the fact that they have all their shells completely filled. 13. We had our laboratory equipped by the beginning of a new academic year. 14. We saw the solution turning blue as the reaction proceeded. 15. They observed the temperature slowly rising.

Ex. 10. Translate the sentences into English.

1. Все химические реакции происходят с различной скоростью. 2. Скорость реакции зависит от состава реагирующих веществ и условий реакции. 3. Существует множество факторов, которые оказывают влияние на реакцию. 4. Среди них прежде всего следует назвать температуру, концентрацию, наличие катализаторов и другие. 5. С точки зрения молекулярной кинетики легко объяснить влияние температуры. 6. Иногда скорость реакции в значительной степени зависит от присутствия катализатора.

Ex. 11. Answer the following questions:

1. What reactions proceed fast? 2. What reactions are usually slow? 3. In what way is silver chloride formed? 4. What example of oxidation-reduction reaction can you give? 5. What factors influence the reaction rate? 6. In what way can one classify these factors?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

catalyst, speed, specific, action, laboratory, industry, biological, system, manufacture, margarine, regulate, enzyme, majority, practically, phenomenon, material, catalysis, elementary, regenerate

Упр. 2. Определите значения выделенных слов по контексту.

1. Among the factors that *alter* the rate of a chemical reaction are temperature, concentration, etc. 2. Sometimes, when the work is especially difficult, we ask for *aid*. 3. A particular property of a catalyst is that it is not *consumed* in the reaction. 4. When a compound has some quantity of a *foreign* substance, it cannot be considered pure.

Слова к тексту:

digestion — переваривание (*пищи*); **augment** — увеличивать; **provide** — обеспечивать

Text 21 B

Прочтите текст про себя (контрольное время чтения — 2,5 минуты).

A Catalyst

A catalyst is a substance that alters the speed of a chemical reaction without itself undergoing any chemical change, usually only a small quantity of it is required.

Catalysts are usually specific in action; thus, a catalyst for one reaction is more often than not useless for any other reaction. They are extremely important substances not only in the laboratory but also in chemical industry and in biological systems. Thus, the manufacture of sulphuric acid, ammonia and margarine involves the application of catalysts, the most of the chemical reactions that occur in our bodies are regulated by these substances. In biological systems substances called enzymes function as catalysts, e. g., specific enzymes are used to aid the digestion of food in the stomach.

Chemists have discovered the great majority of reactions that proceed without catalysts. But there are almost innumerable other reactions that cannot be practically effected without a catalyst.

The phenomenon in which a relatively small amount of a foreign material, called a catalyst, augments the rate of a chemical reaction is called catalysis.

A catalyst provides the possibility of new elementary processes taking place, but it is not consumed during the reaction. If we cannot have it regenerated, there is no catalysis.

Упр. 3. Передайте основное содержание текста в нескольких предложениях.

Упр. 4. Составьте план текста.

Упр. 5. Прочтите предложения и скажите, соответствуют ли они содержанию текста. Если нет, исправьте их.

1. A catalyst is a substance that changes the rate of a chemical reaction. 2. A catalyst undergoes little changes in the reaction. 3. Catalysts are important both in laboratory and in industry. 4. Enzymes are catalysts for biological systems. 5. No reaction can proceed without a catalyst.

Упр. 6. Найдите в тексте предложения, где перечислены отличительные свойства катализа как явления, и переведите их на русский язык.

Section III

Ex. 1. Respond to the following statements. Use the expressions: *quite so*; *I'm of the same opinion*; *really*; *it is not quite so*; *you are absolutely wrong.*

1. It is sometimes difficult to make the reaction proceed faster. 2. There is a tremendous number of factors affecting the reaction. 3. Catalysts are important only in chemical industry. 4. I hear your supervisor has been awarded the State prize for his work. 5. They say you never attend lectures in history. 6. Borodin was not only a chemist

but an outstanding Russian composer as well. 7. Prof. N has been appointed head of your laboratory, hasn't he?

Ex. 2. Translate the sentences into English.

1. Говорят, вы уже на втором курсе? — Не совсем так, я еще на первом. 2. Наш лектор — замечательный ученый. — Действительно. 3. Катализатор влияет на реакцию, но и сам изменяется. — Вы абсолютно неправы, в конце реакции катализатор должен восстанавливаться в первоначальном виде. 4. Катализаторы могут участвовать и в биологических процессах. — Совершенно верно. 5. Катализаторы более важны в промышленности, чем в лаборатории. — Я того же мнения.

Ex. 3. Make up short dialogues according to the model.

Model: — *A statement.*
— *A question.*
— *An answer.*
— *A statement.*

Example:

— My supervisor has published a new article.
— What is the subject of his investigation?
— Ion-selective electrodes.
— It's a very promising field.

Ex. 4. Give detailed answers to the following questions:

1. What is the rate of a reaction? 2. What chemical factors affect the course of a reaction? 3. What physical factors influence the speed of a reaction? 4. What is catalysis? 5. In what way does the presence of a catalyst affect the reaction rate?

Ex. 5. Discuss the following topics:

1. Some Examples of Slow and Fast Reactions.
2. Factors Influencing the Rate of Reactions.
3. Catalysis.

WHAT IS IT?

A substance which can increase the rate of a chemical reaction without itself undergoing permanent chemical change.

Lesson 22

ГРАММАТИКА: Герундий и герундиальный оборот в функции дополнения.

Section I

Ex. 1. Practise your pronunciation.

a) determine [dɪ'tɜ:mɪn], prevail [prɪ'veɪl], consequently ['kɒnsɪkwəntlɪ], identify [aɪ'dentɪfaɪ], inasmuch [ˌɪnəz'mʌtʃ], measurement ['meʒəmənt], height [haɪt], mercury ['mɜ:kjʊrɪ], barometer [bə'rɒmɪtə]

b) the ˌnature ˌof the ˎliquid ˌitself, in ˌthe ˌsame ˎway, it ˌ is ˌ'quite ˌ'true ˌto ˎsay, the ˌ'boiling ˌ'temperature ˌof ˎwater, a 'nother ˌ'unit ˌof ˎpressure

c) An 'increase in the ˌatmo'spheric ˊpressure | 'causes a 'rise in the 'boiling 'point of a ˎliquid.

Ex. 2. Pay attention to the structure of the following words. Translate them into Russian.

a) subatomic, subdivide, subdivision, subgroup, subnormal, substandard

b) decompose, decrease, decentralize, decolourize, deduction, deformation, degradation, dehydration, demagnetize, deoxidize, destruction

c) enable, enlarge, enclose, enforce, enlighten, enrich

Ex. 3. Define the meanings of the word *cause* in the following sentences:

1. An increase in the atmosperic pressure *caused* a rise in the boiling point of a liquid. 2. There is no *cause* to consider these data not reliable. 3. It was necessary to understand what *caused* the explosion. 4. Investigation of peptides is a noble *cause* because it may be of great service in medicine. 5. The decrease of the temperature *caused* the reaction to proceed slower. 6. The circumstances *caused* him to stop his experiments.

Ex. 4. Find the predicate, the subject and the object in the following sentences:

1. A decrease in the atmospheric pressure results in a lowering of a boiling point. 2. A Swedish astronomer A. Celsius is widely known for his having introduced a temperature scale. 3. Selenium is an interesting substance and well worth studying. 4. Selenium and sulphur resemble each other in having analogous chemical properties.

Text 22 A

Factors Affecting the Boiling Point

The temperature at which a liquid boils, is dependent not only upon the nature of the liquid itself, but also upon the pressure prevailing at the time the boiling point is determined. An increase in the atmospheric pressure causes a rise in the boiling point of a liquid; a decrease results in a lowering of the boiling point.

Each individual substance capable of existing in the liquid state has its own definite boiling point. Consequently, this property is used for identifying or characterizing a substance in the same way that density and other physical properties are employed.

Inasmuch as the boiling point of a substance is affected by changes in pressure, it has been found necessary to set up a *standard pressure* at which all boiling points can be compared. A pressure of 760 mm Hg has been selected as the standard. Thus, if the boiling point of water is given as 100° C, the measurement is understood to have been made at a pressure

of 760 mm Hg. Nevertheless, it is quite true to say that the boiling temperature of water is 70°C at a pressure of 233.8 mm Hg; it is also correct to say that carbon tetrachloride boils at a temperature of 70°C, but in this case the pressure is 620 mm Hg. Boiling temperature should not therefore be used for distinguishing one substance from another unless the values used have been determined at the same pressure. Unless otherwise stated*, a boiling point value is understood to be the temperature at which a substance boils under a pressure of 760 mm Hg.

One *atmosphere* (standard atmospheric pressure) is equal to 101.325 kNm^{-2}. It is not an approved SI (International System) unit of pressure, but it is especially important in chemistry because many properties of substances have been measured and recorded at 1-atm pressure. An approved SI unit of pressure is the *pascal* (1 Pa = 1 H/m^2).

Another unit of pressure that has been much used in the past is the *torr*, which is the height in millimetres of a column of mercury that balances the pressure. The symbol mmHg is sometimes used for torr. The name of the unit is taken from the name of the Italian physicist Evangelista Torricelli (1609–1647), known for having invented the mercury barometer. One atmosphere is equal to 760 torr.

Words and Word-Combinations to Be Memorized

approve, balance, boiling point, capable, consequently, decrease, be dependent upon, employ, height, invent, lower, otherwise, record, select, set up, therefore, at the time, unless

Ex. 5. Give the Russian equivalents for the following:

be dependent on (upon), determine the boiling point, exist in the liquid state, consequently, in the same way, be affected by, set up, nevertheless, distinguish one substance from another, unless, be equal to, unit of pressure, be recorded at 1-atm pressure, invent a barometer

Ex. 6. Give the English equivalents for the following:

воздействовать на, природа самой жидкости, вызвать повышение точки кипения, приводить к, каждое отдельное вещество, иметь свою собственную точку кипения, сравнивать, выбрать в качестве стандарта, выполнить измерения, совершенно справедливо, атмосферное давление, итальянский физик, ртутный барометр

Ex. 7. Fill in the blanks with prepositions where necessary.

1. The boiling point ... a liquid is dependent ... the nature of the liquid itself and the pressure. 2. A change ... the atmospheric pressure results ... a changing ... the boiling point. 3. There was a need ... set ... a standard

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* **unless otherwise stated** — если не оговорено особо

pressure. 4. Usually measurements are made ... 1-atm pressure. 5. Standard pressure is taken to be ... a pressure ... 760 mm. 6. Boiling points should be used ... distinguishing one substance ... another only ... the same pressure. 7. Another unit ... pressure is the torr. 8. One atmosphere is equal ... 760 mm.

Ex. 8. Translate the sentences into Russian, paying attention to the constructions *to do* and *to have something done.*

1. The student translated an English article. 2. The student had an English article translated. 3. The student had translated an English article yesterday by 5 o'clock. 4. She sent the letter to her mother. 5. She had her letter sent two days ago. 6. She typed the paper. 7. She had the paper typed for her. 8. Each chemical element has been given its own name. 9. Each chemical element has its own name given to it. 10. Each chemical element has its own name.

Ex. 9. Translate the sentences into Russian.

1. He likes reading. 2. He avoids making complex calculations. 3. There is no need doing it at once. 4. The teacher suggested going on an excursion. 5. Don't use this apparatus, it wants repairing. 6. Excuse my being late. 7. Now I am very careful in the laboratory, I can't forget my having burnt my left hand with an acid. 8. They were sorry for having missed the last lecture. 9. The student denied the laboratory assistant having helped him with the experiment. 10. I don't mind my sister's taking my notes. 11. Under ordinary conditions the precipitate may fail to begin forming. 12. It is necessary to practise identifying the constituent elements of a sample. 13. The fundamental chemical laws are worth studying. 14. The conference is going to be very interesting, we cannot help going there. 15. Mendeleyev's wide interests in various sciences did not prevent him from taking part in social life. 16. Alkali metals are capable of reacting with a number of the non-metals, forming binary products, e. g., chlorides, bromides, etc. 17. Before working in the laboratory, students must learn what measures should be taken against being poisoned by chemicals. 18. Everybody knows of D. I. Mendeleyev's having organized the Chamber of Weights and Measures in Russia. 19. Alchemists succeeded in both preparing a number of new elements and inventing useful pieces of apparatus. 20. S. V. Lebedev succeeded in making the first synthetic rubber in the world.

Ex. 10. Translate the sentences into English.

1. Есть необходимость знать факторы, которые оказывают влияние на точку кипения вещества. 2. Главными из таких факторов являются: природа самого вещества, температура и давление. 3. Повышение атмосферного давления, как известно, приводит к повышению точки кипения жидкости. 4. Для получения сравнимых результатов следует проводить измерения при одинаковом давлении. 5. Давление в 760 мм ртутного столба принято как стандартное давление в 1 ат-

мосферу. 6. Другой единицей давления, которой часто пользовались в прошлом, а иногда пользуются и сейчас, является торр. 7. 1 торр равен $^1/_{760}$ атмосферы, название происходит от имени итальянского физика Э. Торричелли.

Ex. 11. Answer the following questions:

1. What factors is the boiling point of a liquid dependent on? 2. How does the atmospheric pressure affect the boiling point? 3. What was the need of setting up a standard pressure? 4. What pressure was selected as a standard? 5. In what way can the boiling point be used in comparing the substances? 6. What do we mean if the pressure is not pointed out in the description of an experiment? 7. What other units of pressure do you know?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

scale, object, contact, thermal, energy, ordinarily, thermometer, astronomy, philosopher, alcohol, normal, human, calibrate, convert, absolute, engineer

Упр. 2. Определите значения выделенных слов по контексту.

1. He had lived in Leningrad before 1990 and then *settled* in Moscow. 2. It's rather warm today, what temperature is it? — 16 *degrees*. 3. The analysis is easier to make *by means of* a microscope. 4. We have *devised* a perfect plan of doing the work.

Слова к тексту:

quality — качество; **tube** — трубка; **centigrade scale** — стоградусная шкала; **Swedish** — шведский; **choice** — выбор; **perhaps** — возможно; **fever** — жар, лихорадка; **saturate** — насыщать

Text 22 B

Прочтите текст про себя (контрольное время чтения — 4,5 минуты).

Temperature Scales

If two objects are placed in contact with one another, thermal energy may flow from one object to the other one. *Temperature* is the quality that determines the direction in which thermal energy flows — it flows from the object at higher temperature to the object at lower temperature.

Temperatures are ordinarily measured by means of a thermometer, such as the ordinary mercury thermometer, consisting of a quantity of mercury in a glass tube. The temperature scale used by scientists is the *centigrade* or *Celsius scale*; it was introduced by Anders Celsius (1701–1744), a Swedish professor of astronomy, in 1742. On this scale the

temperature of freezing water saturated with air is 0°C and the temperature of boiling water is 100°C at 1-atm pressure.

On the *Fahrenheit scale*, used in everyday life in English-speaking countries, the freezing point of water is 32°F and the boiling point of water is 212°F. On this scale the freezing point and the boiling point differ by 180°, rather than 100° of the centigrade scale. The Fahrenheit scale was devised by Gabriel Fahrenheit (1686–1736), a natural philosopher who was born in Danzig and settled in Holland. He invented the mercury thermometer in 1714; before then, alcohol had been used as the liquid in thermometers. As the zero point on his scale he took the lowest temperature he could obtain, produced by mixing equal quantities of snow and ammonium chloride. His choice of 212° for the boiling point of water was made in order that the temperature of his body should be 100°F. The normal temperature of the human body is 98.6°F; perhaps Fahrenheit had a slight fever while he was calibrating his thermometer.

To convert temperatures from one scale to another, you need only remember that the Fahrenheit degree is $^{100}/_{180}$ or $^{5}/_{9}$ of the centigrade degree, and that 0°C is the same temperature as 32°F.

Another absolute scale, the *Rankine scale*, is sometimes used in engineering work in the English-speaking countries. It uses the Fahrenheit degree, and has 0°R as the absolute zero.

Упр. 3. Передайте основное содержание текста в нескольких предложениях.

Упр. 4. Составьте план текста.

Упр. 5. Прочтите предложения и скажите, соответствуют ли они содержанию текста. Если нет, исправьте их.

1. Temperature determines the direction in which thermal energy flows when the two objects are in contact. 2. Thermal energy flows from the hotter object to the colder one. 3. Temperature is measured by means of thermometers using different temperature scales. 4. The inventor of the Fahrenheit scale was German. 5. Fahrenheit devised alcohol thermometer. 6. Only the Fahrenheit scale is used in the English-speaking countries. 7. The temperature of the boiling water is 100 degrees centigrade. 8. The inventor of the centigrade scale was an outstanding physicist.

Упр. 6. Найдите в тексте и переведите на русский язык предложения в которых дано описание того, как перевести значение температуры с одной шкалы на другую.

Section III

Ex. 1. Respond to the following using the verbs *to listen* and *to hear*:

1. I didn't hear what he said, did you? 2. What kind of music do you like to listen to? 3. It seems to me that somebody is calling me, do you hear? 4. I don't like to listen to the radio and what about you? 5. The teacher

is speaking so quietly, I can hardly hear him. 6. Usually, small children like to listen to fairytales before going to bed and what about your sister? 7. The bell is ringing, the lesson is over, but the teacher seems not to hear.

Ex. 2. Translate the sentences into English.

1. Кажется, телефон звонит, вы слышите? 2. По-моему, что-то упало, вы слышали? 3. Мой брат может целый вечер слушать классическую музыку, а я люблю слушать джаз. 4. Здесь очень шумно, я почти ничего не слышу. 5. Лекция довольно интересная, а ее почти никто не слушает. 6. Он слушает новые записи. Кажется, они ему нравятся. 7. Не слушайте его, он сам не знает, что говорит. 8. Я слышал, наш руководитель уже приехал из Москвы.

Ex. 3. Make up short dialogues according to the model.

Model: — *A statement.*
— *A statement.*
— *A question.*
— *An answer.*

Example:
— I hear some students are engaged in scientific work.
— And as far as I know, almost every undergraduate does a more or less serious research.
— Who helps them?
— Their supervisor.

Ex. 4. Give detailed answers to the following questions:

1. What is temperature? 2. In what way can the boiling point of a liquid be determined? 3. What are the factors that affect the boiling point? 4. What units of pressure are used in chemistry? 5. What temperature scales do you know?

Ex. 5. Discuss the following topics:

1. The Boiling Point as a Physical Factor.
2. Means of Measuring Pressure.
3. Temperature Scales.

WHAT IS IT?

An instrument for measuring the pressure of the atmosphere.

Lesson 23

ГРАММАТИКА: Придаточное предложение в функции дополнения.

Section I

Ex. 1. Practise your pronunciation.

a) measure ['meʒə], centigrade ['sentɪgreɪd], advance [əd'vɑ:ns], usage ['ju:zɪdʒ], bureau ['bjʊərəʊ], adopt [ə'dɒpt], committee [kə'mɪtɪ], law [lɔ:], govern

['gʌvən], decision [dɪ'sɪʒən], analogous [ə'næləgəs], previously ['pri:vɪəslɪ], ambiguous [æm'bɪgjuəs], thoroughly ['θʌrəlɪ], tongue [tʌŋ], draft [drɑ:ft]

b) for the 'scale of \temperature, in ad'vance of the \conference, o'fficial \language, the pro'posed \text, in 'English 'speaking \countries, it might be \argued

c) It might be re/'marked | that/'Celsius | was a'nalogous to the 'names /'Kelvin, | /'Fahrenheit, | /'Reaumur | and \Rankine | 'used for 'other 'temperature \scales.

Ex. 2. Pay attention to the structure of the following words. Translate them into Russian.

a) international, interact, interchange, interrelation, interview, intermediate

b) transform, transformation, translation, translocation, transmission, transport, transuranium, transvalue

c) supercool, superheat, superman, supernatural, supersaturate, supervision, superconductivity

Ex. 3. Define the meanings of the word *appear* in the following sentences:

1. When the atomic hypothesis *appeared*, there was no direct evidence of the existence of atoms. 2. Oxygen was first obtained by heating various compounds of it, particularly mercuric oxide, and the first account of the work *appeared* in 1774. 3. It *appears* that about one-fifth of the air by volume is oxygen. 4. She *appeared* frightened when the door suddenly opened and somebody came in. 5. In the interest of uniformity the use of "Celsius" *appeared* desirable. 6. The electrons and the nucleus occupy only a small portion of the whole space of the atom, therefore, it *appears* to be composed largely of empty space. 7. It *appears* that many reactions with oxygen liberate heat and light. 8. He *appears* to be able to do it himself.

Ex. 4. Find the predicate, the subject and the object in the following sentences:

1. It was known that Celsius had previously been used in some countries. 2. It is quite correct to say that carbon tetrachloride boils at a temperature of 70°, if the pressure is 620 mm Hg. 3. It is necessary that you should know how to convert temperature from one scale to another.

Text 23 A

Celsius versus Centigrade

The Ninth General Conference on Weights and Measures, held in October, 1948, adopted the name "Celsius" for the scale of temperature which had more commonly been called "centigrade". This action, which had not been proposed in advance of the Conference, arose from a question regarding preferred usage in French, the sole official language of the Conference. The decision might be considered as applying strictly only to that language. In the interest of eventual uniformity of practice the use of

"Celsius" appeared desirable, but it was not practicable to impose this term on those who preferred "centigrade".

In preparation for the General Conference the National Bureau of Standard submitted a revised text defining the International Temperature Scale to supersede that adopted in 1927. The proposed text was drafted in English and, in accordance with common English practice as well as the official French text adopted in 1927, it used the name "centigrade". This name was carried over into the French translation prepared for consideraton by the Advisory Committee on Thermometry in May, 1948. However, in the printed report of that meeting, the term "centigrade" had, in most cases, been changed to "centesimal", the term that was used in the French law governing weights and measurements. When it was asked to choose between the two, the International Committee on Weights and the General Conference voted to substitute "Celsius".

With regard to the merits of the decision it might be remarked that Celsius (abbreviated C) was analogous to the names *Kelvin, Fahrenheit, Reaumur*, and *Rankine*, used for other temperature scales, that it had previously been used considerably in some countries, and occasionally in America. It might also be argued that "centigrade" was logically ambiguous, since the absolute *Kelvin scale*, as well as the *centigrade scale* has 100 degrees between the ice point and the boiling point of water. On the other hand, the name "centigrade" was thoroughly established in English-speaking countries, the need for choosing between that name and "centesimal" arose only in French, and the decision on a term in the official French language of the Conference might not be considered as controlling the terms to be used in translating into other tongues.

Words and Word-Combinations to Be Memorized

absolute, adopt, advance, analogue, it appears, carry, conference, control, decision, degree, desirable, occasionally, practice, prefer, report, substitute, term, thoroughly, translation

Ex. 5. Give the Russian equivalents for the following:

hold a conference, adopt the name, propose an action, uniformity of practice, be practicable, prepare for consideration, advisory committee, with regard to, remark, occasionally, on the other hand, thoroughly, in the English-speaking countries, the need for, translate into, use the term, previously, in accordance with

Ex. 6. Give the English equivalents for the following:

конференция по вопросам мер и весов, провести конференцию, шкала температур, официальный язык конференции, в интересах чего-л., предпочитать, международная шкала температур, обычная практика, подготовить перевод, напечатанный отчет, в большинстве

случаев, пользоваться термином, в некоторых странах, необходимость выбора

Ex. 7. Fill in the blanks with prepositions where necessary.

1. The Ninth General Conference ... Weights and Measures was held ... October, 1948. 2. The conference adopted ... the name "Celsius" ... the scale ... temperature. 3. ... the interest ... uniformity ... practice the use ... "Celsius" appeared desirable. 4. Celsius was analogous ... the names ... Kelvin, Fahrenheit and others. 5. The name "centigrade" was thoroughly established ... English-speaking countries. 6. The absolute Kelvin scale and the centigrade scale have 100 degrees ... the ice point and the boiling point ... water.

Ex. 8. Translate the sentences into Russian, paying attention to different functions of the word *use*.

1. Oxygen is widely *used* in industry. 2. Today there is practically no industry which does not *use* the oxy-acetylene process. 3. He is not *used* to work with this apparatus, help him, please. 4. Formerly hydrogen *used* to be classed with the alkali metals of Group I in the priodic table. 5. They *used* a fine balance in their measurements. 6. Reduction of SiO_2 with carbon in an electric furnace is a commercial method of preparing silicon now in *use*. 7. There are two *uses* of the word "theory". 8. *Use* must be made of the ability of the substance to ignite spontaneously. 9. It is no *use* making calculations if the measurements were not accurate.

Ex. 9. Translate the sentences into Russian.

1. There is no doubt that chemistry is of great service to medicine. 2. They have just read how oxygen was produced. 3. The laboratory assistant showed us where the chemicals were stored. 4. We don't know whether the library is open now. 5. He says he works in the laboratory of organic chemistry. 6. She told us that she had been present at the seminar and could show us her notes. 7. Everybody knew that Dr. N had been working on the subject for a long time before making his report at the conference. 8. He said he would go to Moscow next week. 9. We thought we should have done our experiment by that time. 10. She said she would be working in the library at 3 o'clock. 11. The teacher asked me what I was doing. 12. I asked her whether she had finished the exercise. 13. It is not known how and when glass was first obtained. 14. It is often necessary to determine if any particular substance is a mixture or a solution. 15. Every student knows he must be careful when he works in the laboratory. 16. One can say pure oxygen is a colourless, odourless and tasteless gas. 17. Every chemist knows that it was in 1869 that Mendeleyev's article on the periodic system was published. 18. Mendeleyev's law stated that the properties of elements are periodic functions of their atomic weights. 19. It is absolutely necessary that we should

know what substances we are going to obtain in a reaction. 20. Temperature does not depend on how much matter is present. 21. It is necessary that the temperature should be kept constant. 22. The supervisor insisted that we should learn the instruction. 23. It is desirable that Dr. N should speak at the conference. 24. It is essential that oxidation state should be known. 25. Our supervisor proposed that we should write a joint paper. 26. The teacher advised that the student should consult a reference-book. 27. It was necessary to prove whether the conclusion that was made in the paper was right. 28. It was my colleague who recommended that the pressure of the reacting substances should be increased. 29. Much depends on what the conditions of a reaction are. 30. Sometimes it is difficult to decide what term should be used, because there is no uniformity in the nomenclature.

Ex. 10. Translate the sentences into English.

1. На конференции 1948 года было принято название «шкала Цельсия» для стоградусной шкалы температур. 2. По шкале Цельсия вода замерзает при 0°С, кипит при 100°С. 3. Следует отметить, что это название было выбрано по аналогии с такими названиями, как шкала Кельвина, шкала Фаренгейта и др. 4. Это решение было принято в интересах единообразия при практическом применении. 5. Термин «шкала Цельсия» более точен, так как шкала Кельвина — это тоже стоградусная шкала. 6. В англоязычных странах в повседневной жизни продолжают пользоваться шкалой Фаренгейта. 7. Шкала Реомюра имеет 80 делений между точкой замерзания и точкой кипения воды.

Ex. 11. Answer the following questions:

1. What problems were discussed at the conference in 1948? 2. What name was adopted for the temperature scale devised by Celsius? 3. What was the reason for choosing a single name for the scale? 4. Why was the name "Celsius" considered preferable? 5. What other name for this scale do you know? 6. What other temperature scales do you know? 7. What temperature scales are used in Russia?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

modern, regular, concept, minimum, thermodynamics, equilibrium, discuss, gas, thermometer, instrument, accurate, atmosphere, definition

Упр. 2. Определите значения выделенных слов по контексту.

1. One can easily obtain spectrum by *means* of a spectroscope. 2. The glass is *filled* with water. 3. Microscope is a common *device* that is used when it is necessary to see small particles. 4. The *purpose* of this

investigation is to determine the best conditions for the reaction. 5. Sometimes we use ice to *cool* the body.

Слова к тексту:

devise — придумать; **triple** — тройной; **saturate** — насыщать; **hence** — следовательно; **convenience** — удобство; **resistance** — сопротивление; **thermocouple** — термопара

Text 23 B

Прочтите текст про себя (контрольное время чтения — 4 минуты).

The Kelvin Temperature Scale and Modern Means of Measuring the Temperature

About 200 years ago scientists noticed that a sample of gas that is cooled decreases in volume in a regular way, and they saw that if the volume were to continue to decrease in the same way, it would become zero at about –273°C. The concept was developed that this temperature –273°C (more accurately –273.15°C) is the minimum temperature, the *absolute zero*. A new temperature scale was then devised by Lord Kelvin, a great British physicist (1824–1907). The *Kelvin scale* is defined in such a way as to permit the laws of thermodynamics to be expressed in a simple form.

The International Standard temperature scale is the Kelvin scale with a new definition of the degree. The absolute zero is taken to be 0K and the triple point of water is taken to be 273.15K. (The triple point of water, the temperature at which pure liquid water, ice and water vapour are in equilibrium, will be discussed later.) With this definition of the degree, the boiling point of water at one-atmosphere pressure is 373.15K and the freezing point of water saturated with air at one-atmosphere pressure is 273.15K. Hence the SI Kelvin temperature is 273.15K greater than the centigrade temperature.

Gas Thermometer

The establishment of the International Temperature Scale has required that the thermodynamic temperatures of the fixed points be determined with as much accuracy as possible. For this purpose a device was needed that measures essentially the themodynamic temperature and does not depend on any particular thermometric substance. On the other hand, since it was needed only for a few highly accurate measurements, it did not need to have the convenience of such instruments as resistance thermometers, mercury thermometers, and thermocouples. The device that has filled this need is the *gas thermometer*.

Упр. 3. Передайте основное содержание текста в нескольких предложениях.

Упр. 4. Составьте план текста.

Упр. 5. Прочтите предложения и скажите, соответствуют ли они содержанию текста. Если нет, исправьте их.

1. More than a century ago scientists noticed the dependence between the temperature and the volume of a gas. 2. The temperature at which the volume of the gas sample would become zero was named the absolute zero. 3. The scale according to which the absolute zero is taken to be 0° is the International Standard temperature scale. 4. The triple point of water is the temperature when vapourization begins. 5. The temperature by the Kelvin scale is the temperature by Celsius scale plus 273.15°. 6. Gas thermometer is used for ordinary measurements. 7. Gas thermometer is a convenient instrument. 8. This device is highly accurate.

Ex. 6. Найдите в тексте описание того, как ученые пришли к концепции абсолютного нуля, переведите эти предложения на русский язык.

Section III

Ex. 1. Respond to the following statements using the expressions: *I believe so*; *in my (his, her, your, etc.) opinion*; *you are quite right*; *I'm afraid you are wrong*; *just the reverse.*

1. It's not very convenient that there are so many temperature scales. 2. It is easy to count the temperature by the Kelvin scale if you know the temperature by the Celsius scale. 3. It is much easier to use only one temperature scale. 4. I think the devices for measuring the temperature are either not accurate or not convenient. 5. It is for the first time that I hear about the Rankine scale, it is used in France, isn't it? 6. She says temperature is not very important in this procedure. 7. I think it would be right to prepare the chemicals first.

Ex. 2. Translate the sentences into English.

1. Уже скоро 7 часов, он, наверное, скоро придет. — Полагаю, да. 2. Мне кажется, у нас слишком много времени уходит на лабораторные работы. — А по моему мнению, это правильно: химик должен уметь работать руками. 3. Вы пропустили много занятий, вам необходимо изучить весь материал самостоятельно. — Вы совершенно правы. С чего мне лучше начать? 4. Я знаю только шкалу Цельсия, кажется, у нас пользуются только ею. — Боюсь, что вы неправы. Я знаю, например, что физики и химики широко пользуются шкалой Кельвина. 5. Я слышал, он жил в Минске, а потом переехал в Москву. — Как раз наоборот. В прошлом году в Минске открылась новая лаборатория, и он поехал туда работать.

Ex. 3. Make up short dialogues according to the model.

Model: — *A question.*
— *A clarifying question.*
— *An answer.*
— *A statement.*

Example:

— I didn't like all the subjects when I was a pupil.
— What subjects didn't you like?
— English, for example.
— As for me, I didn't like history.

Ex. 4. Give detailed answers to the questions.

1. What temperature scales do you know? 2. How was the International Standard scale adopted? 3. What are the most widely used temperature scales? 4. In what way can one convert the temperature from one scale to another? 5. What instruments are used for temperature measurements?

Ex. 5. Discuss the following topics:

1. The Problem of Uniformity in Measuring the Temperature.
2. Different Temperature Scales.
3. Means of Measuring the Temperature.

WHAT IS IT?

A unit in a temperature scale.

Lesson 24

ГРАММАТИКА: Повторение тем «Подлежащее» и «Дополнение»

Section I

Ex. 1. Practise your pronunciation.

a) recognize ['rekəgnaɪz], relative ['relətɪv], carefully ['keəfʊlɪ], determine [dɪ'tɜ:mɪn], electrolysis [ɪlek'trɒlɪsɪs], unique [ju:'nɪk], subsequent ['sʌbsɪkwənt], aqueous ['eɪkwɪəs], observation [ˌɒbzə'veɪʃən], isolate ['aɪsəleɪt], phase [feɪz], hybridize ['haɪbrɪdaɪz]

b) is ˌburned ˌin ↘air, 'weight ˌof ↘oxygen, the a'mount ˌof ↘hydrogen, with ˌthese ˌobser'vations, 'neighbouring ˌwater ↘molecules

c) 'Water was 'thought by the ↗ancients | to be an ↘element.

Ex. 2. Pay attention to the structure of the following words. Translate them into Russian.

a) undergo, underestimate, underdeveloped, undergraduate, underground, underline, understand

b) misunderstand, misadvise, misbehave, miscalculate, misconception, mishandle, mishear, misinform, mispronounce, mistake

c) semiautomatic, semiconductor, semiannual, semifluid

Ex. 3. Define the meanings of the word *both* in the following sentences:

1. Combustion is a chemical reaction which takes place with the evolution of *both* light and heat. 2. As to sulphur and oxygen, it should be noted that *both* of these elements have allotropic modifications. 3. Which of the two seasons do you like better — summer or autumn? — As for me, I like *both*. 4. Solutions are very important kinds of matter — *both* for industry and for life. 5. *Both* of the substances (barium sulphate and silicon dioxide) are practically insoluble in water. 6. What is the matter with M and N, they *both* are absent again? 7. *Both* sodium and potassium belong to the same family of elements, it is not surprising that they have similar properties.

Ex. 4. Find the predicate, the subject and the object in the following sentences:

1. Lavoisier first recognized that water is a compound of the two elements, hydrogen and oxygen. 2. The structure of water must be fundamentally different from that of most other liquids. 3. The characteristic increase in the density of water with temperature is found to continue until 4°C.

Text 24 A

The Composition and Structure of Water

Water was thought by the ancients to be an element. Henry Cavendish in 1781 showed that water is formed when hydrogen is burned in air, and Lavoisier first recognized that water is a compound of the two elements — hydrogen and oxygen.

The formula of water is H_2O. The relative weights of hydrogen and oxygen in the substance have been very carefully determined as 2.016:16.000. This determination has been made both by weighing the amounts of hydrogen and oxygen liberated from water by electrolysis and by determining the weights of hydrogen and oxygen that combine to form water.

Liquid water has a number of unique properties which indicate that the structure must be fundamentally different from that of most other liquids. Thus, water has high melting and boiling points, an unusually high heat capacity, and shows a characteristic decrease in molar volume on melting and a subsequent contraction between 0 and 4°C. Quite apart from the behaviour of aqueous solutions, any proposed structure for liquid water must be consistent with these observations.

From spectroscopic studies of isolated water molecules in the gas phase, it has been shown that the H—O—H bond angle is very nearly the tetrahedral angle of 105° and the O—H internuclear distance is 0.97Ē; the observed dipole moment is 1.87×10^{-18} e.s.u.* acting along the bisector of the H—O—H angle.

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* e.s.u. — electrostatic unit

Bernal and Fowler in a classical work on the interpretation of these results, showed that the net electronic density distribution was consistent with such a structure in which, in addition to the two protons carrying small positive charges, there are also two regions of negative charge. These four regions of charge, two positive and two negative, could be regarded as residing at the corners of a tetrahedron. If the oxygen is approximately sp^3 hybridized then two of the orbitals on the oxygen atom are used for bonding the hydrogen atoms and the other two carry the lone pairs of electrons which can participate in hydrogen bonds to two neighbouring water molecules. In terms of this picture the structure of ice, in which each molecule has four nearest neighbours, can be represented in the following way. The molecules are held together by tetrahedrally-directed hydrogen bonds which are essentially electrostatic in character. The structure is an open one rather than a close-packed with a resulting increase in density. The characteristic increase in density with temperature continues until 4°C when the expected decrease accompanying the increased thermal energy becomes apparent.

Words and Word-Combinations to Be Memorized

accompany, apart, apparent, aqueous, behaviour, capacity, careful, character, charge, consistent, dipole, energy, expect, liberate, moment, net, a number of, observation, partial, participate, positive, region, spectroscope, static, unusually

Ex. 5. Give the Russian equivalents for the following:

relative weights, determine very carefully, liberate hydrogen, a number of unique properties, heat capacity, the behaviour of aqueous solutions, be consistent with, spectroscopic studies, the bond angle, the interpretation of results, in addition to the protons, positive charge, at the corners of a tetrahedron, participate in hydrogen bonds, represent the structure, be electrostatic in character, thermal energy

Ex. 6. Give the English equivalents for the following:

состав воды, на воздухе, признавать, жидкая вода, отличаться от, высокие точки плавления и кипения, необычно высокая теплоемкость, в газовой фазе, межъядерное расстояние, классическая работа, отрицательный заряд, водородная связь, соседние молекулы воды, структура льда, следующим образом, удерживать вместе, быть каким-л. по характеру, а не частичное разрушение структуры, увеличение плотности, ожидаемое уменьшение, становиться очевидным

Ex. 7. Fill in the blanks with prepositions where necessary.

1. Cavendish ... 1781 showed water to be formed when oxygen is burned ... air. 2. The relative weights ... hydrogen and oxygen ... the substance were very carefully determined. 3. Water ... the liquid phase has a number ... unique properties. 4. The structure ... water is different

... that ... most ... other liquids. 5. It was shown ... spectroscopic studies that the H—O—H bond angle is very nearly the tetrahedral angle ... 105°. 6. The molecules ... ice are held together ... tetrahedrally-directed hydrogen bonds. 7. These bonds are essentially electrostatic ... character.

Ex. 8. Translate the sentences into Russian, paying attention to different functions of the word *will*.

1. The laboratory of analytical chemistry *will* soon be transferred to a new building. 2. Heating *will* affect the state of water but not its composition. 3. Other ways of obtaining hydrogen *will* be discussed in the next chapter. 4. Water is usually called a universal solvent because it *will* dissolve a tremendous number of substances. 5. *Will* you give me your dictionary for a couple of days? 6. He went to the university against his father's *will*. 7. There *will* be no difficulty in making calculations.

Ex. 9. Translate the sentences into Russian.

1. That air is not a chemical compound is now known even to children, but there was a time when it was thought to be an element. 2. The chemists have many problems to solve, particularly environmental ones. 3. One has to remember that a reaction with the liberation of heat may be followed by an explosion. 4. It is sometimes not easy to decide what catalyst should be used. 5. For a number of chemical processes it is desirable to use distilled water. 6. To obtain sufficiently pure water is one of the urgent problems of the day, especially in chemical and paper industries. 7. Boiling is one of the simplest ways of purifying water. 8. Barium sulphate is only slightly soluble, one can easily separate it by means of a filter. 9. They watched the temperature rising, but at the temperature of 69 degrees the process stopped. 10. Phosphorus is very interesting by existing in several allotropic forms. 11. Never take white phosphorus with bare hands because heat of the body is enough to ignite it. 12. It is its activity with oxygen that is the most striking property of phosphorus. 13. Compounds of silicon are found to make up about 87 per cent of the outer layer of the solid earth. 14. Atoms are generally known to be electrically neutral. 15. Hydrogen atom is stated to contain no neutrons. 16. They supposed the substance to react at room temperature, but it wouldn't. 17. Combining the two mixtures may result in an explosion. 18. To find free chlorine in nature is impossible because of its exceedingly high activity. 19. Chlorine is considered to be a typical non-metal. 20. For hydrogen to combine with chlorine with appreciable velocity in the dark is possible in the presence of a catalyst. 21. The experiments show chlorine to be an active oxidizing agent. 22. That the lightest of the alkali metals is lithium can be determined by its position in the periodic table. 23. One can observe caesium taking fire at ordinary temperature. 24. Molecular structure of nitrogen allows the properties of this element to be accounted for. 25. Nitrogen can be made to form ammonia by use of a suitable catalyst. 26. Whether the hypothesis is

true must be verified experimentally. 27. The aim of this experiment is to show whether sulphuric acid will react with metals. 28. Lomonosov's being the first who formulated the second law of thermodynamics is seldom mentioned. 29. It is heating that forces many reactions to take place. 30. A great number of elements have been found to have two or more isotopes.

Ex. 10. Translate the sentences into English.

1. В древние времена считали, что вода — это один из элементов. 2. Только в конце XVIII столетия было доказано, что вода состоит из двух элементов — водорода и кислорода. 3. Теперь каждому школьнику известно, что формула воды — H_2O. 4. Вода в жидком состоянии обладает рядом уникальных свойств. 5. То, что вода — необычная жидкость, объясняется ее структурой. 6. Интересно также изучение воды в газообразной и твердой фазе. 7. Характерными физическими свойствами воды можно назвать высокие точки плавления и кипения, а также теплоемкость.

Ex. 11. Answer the following questions:

1. By means of what experiment was it shown that water is a compound? 2. What is the composition of water? 3. What properties show water to be a unique liquid? 4. In what way can the properties of water be accounted for? 5. What did spectroscopic studies of water molecules show? 6. In what way are the atoms in the water molecule held together?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

component, ion, metal, ocean, complex, organic, organism, course, plasma, extensively, correlate, universal, barium, sulphate, milligram, litre, quartz, extremely, cellulose

Упр. 2. Определите значения выделенных слов по контексту.

1. The *ability* of water to dissolve many substances is one of its unique properties. 2. Heat and light are usually *evolved* during combustion. 3. A substance that is dissolved is called a *solute*. 4. Water is *widely* used both in industry and in laboratory. 5. If a solution of NaCl is evaporated to *dryness*, white crystals appear in the glass. 6. If a solution is *saturated*, no more solute can be dissolved.

Слова к тексту:

environment — окружающая среда; **tissue** — ткань; **fluid** — жидкость; **blood** — кровь; **cell** — клетка; **imperceptible** — незаметный, незначительный; **vessel** — сосуд; **eventually** — в конце концов; **merely** — просто; **exceedingly** — чрезвычайно

Text 24 B

Прочтите текст про себя (контрольное время чтения — 4 минуты).

Water

One of the most striking properties of water is its ability to dissolve many substances, forming *aqueous solutions*. Solutions are very important kinds of matter — important for industry and for life. The ocean is an aqueous solution that contains thousands of components: ions of the metals and non-metals, complex organic ions, many different organic substances. It was in this solution that the first living organisms developed, and it was from it that they obtained the ions and molecules needed for their growth and life. In the course of time organisms that were evolved could leave this aqueous environment, and move out onto the land and into the air. They achieved this ability by carrying the aqueous solution with them, as tissue fluid, blood plasma, and intracellular fluids containing the necessary supply of ions and molecules.

The properties of solution have been extensively studied, and it has been found that they can be correlated in large part by some simple laws.

Water not only is the most widely used of all solvents, but also, of all liquids, it most nearly approaches being the "universal solvent". Every substance is probably soluble in water to some extent, although in many cases the solubility is so small that it is almost imperseptible. Thus, a saturated solution of barium sulphate contains less than a quarter of a milligram of solute per litre, and the solubility of silicon dioxide (quartz) — is even smaller than this. Yet, water that is allowed to remain for a long time in a quartz vessel must eventually become saturated with quartz; a saturated solution of this substance is so extremely dilute, however, that many litres of it would have to be evaporated to dryness in order to yield a visible residue. Such substances as barium sulphate, silver chloride, quartz, glass, mercury, and cellulose are usually considered as "insoluble" in water; but this term, it must be remembered, is merely a relative one, and it would be more accurate to say that their solubility is exceedingly small.

Упр. 3. Передайте основное содержание текста в нескольких предложениях.

Упр. 4. Составьте план текста.

Упр. 5. Прочтите предложения и скажите, соответствуют ли они содержанию текста. Если нет, исправьте их.

1. Water can dissolve a great number of substances. 2. Solutions are important in industry, but not in life. 3. A lot of components are dissolved in the ocean water. 4. The first living organisms developed in water and on the land and then moved into the air. 5. There are no laws common to all the solutions and the properties of each solution are studied separately. 6. Every substance is soluble in water to some extent.

Упр. 6. Найдите в тексте и переведите на русский язык предложения с описанием того, как ведут себя в воде вещества, которые считаются практически нерастворимыми.

Section III

Ex. 1. Respond to the statements and questions, using the following expressions: *I hope so*; *so it is*; *it is*; *it would be wrong to say so*; *I'm of the same opinion.*

1. I think we speak too much about water, there are many other interesting liquids. 2. Barium sulphate is insoluble in water. 3. The ocean is an aqueous solution, isn't it? 4. It was in the ocean that the first living organisms developed. 5. Could we obtain a solution of quartz? 6. Thus, in conclusion we may say that the term "insoluble" in water is not accurate when we speak about silver chloride. 7. Water is usually called the "universal solvent". 8. Soon we shall learn the structure of water and then we shall clearly understand the nature of its properties.

Ex. 2. Translate the sentences into English.

1. Тысячи компонентов различных веществ растворены в воде океана. — Да, это так. 2. Наверное, прошло много времени, прежде чем живые организмы вышли из океана на сушу. — Я тоже так думаю. 3. Свойства растворов хорошо известны, и мы тоже скоро будем их изучать. — Надеюсь. 4. Есть вещества, например, сульфат бария, которые не растворяются в воде. — Было бы неверно так говорить, потому что он растворяется, только очень мало. 5. Структура воды уникальна. — Да. 6. Теплоемкость воды необычно высока. — Да, это так.

Ex. 3. Make up short dialogues according to the model.

Model: — *A request*
— *A clarifying question.*
— *A statement.*
— *An answer.*

Example:

— Could you help me with my homework?
— What is the difficulty?
— I can't understand this rule.
— I'll try to explain it to you.

Ex. 4. Give detailed answers to the following questions:

1. What can you say about water in nature? 2. What is the composition of water? 3. What properties make it a unique liquid? 4. What is the structure of water interesting for?

Ex. 5. Discuss the following topics:

1. The Physical Properties of Water.
2. The Structure of Water.
3. Water as a Universal Solvent.

WHAT IS IT?

A part of a solution which is present in greater amount.

Part Four

THE ATTRIBUTE

Lesson 25

ГРАММАТИКА: Определение. Прилагательное, местоимение, существительное, наречие в функции определения.

Section I

Ex. 1. Practise your reading.

The subject of acids and bases led to the development of an interesting series of theories.

Ex. 2. State what parts of speech the following words belong to:

acid, acidity, acidic, acidate, acidification, acidifier

Ex. 3. Define the meanings of the word *any* in the following sentences:

1. Are there *any* test-tubes on the table? 2. *Any* student of chemistry must know the periodic law. 3. There is not *any* student in the lab. 4. According to Arrhenius, *any* hydroxy compound giving hydroxyl ions in water solution was called a base. 5. There are not *any* flowers on the windows in our classroom. 6. There are few objections to this theory, if there are *any*. 7. The protonic theory states that a base is *any* substance, molecule, or ion, which accepts a proton. 8. There is little chance, if *any*, for the reaction to be completed because the temperature is too low.

Ex. 4. Analyse the following sentence:

The subject of acids and bases has long been one of the most controversial in chemistry.

Text 25 A

Bases

The subject of acids and bases has long been one of the most controversial in chemistry, and led to the development of an interesting series of theories.

In the 17th century, during the infancy of experimental chemistry, acids and bases were defined or described on the basis of their behaviour. Thus, bases were substances that neutralized acids, turned plant dyes blue, had a bitter taste, and had a smooth or slippery feeling to the skin.

In the 18th century, following the discovery of oxygen by Joseph Priestley, Lavoisier advanced the idea that oxygen was the acidifying principle of all acids. Thereafter, the experimental approach was largely abandoned and emphasis was placed on the composition of substances instead of the phenomenological properties. The development of the hydrogen theory of acidity and Faraday's studies of electrolytic conductance in the early 19th century led logically to the water-ion theory proposed by Arrhenius. By this concept a base may be defined as any hydroxy compound which gives hydroxyl ions in water solution. Neutralization then involves the combination of hydroxyl ions with hydrogen formed by the acid, producing water and incidentally a salt. The role of solvent as an ionizing medium for acid-base reactions was emphasized. Although the theory under consideration was very useful and adequate for many reactions in aqueous solution, its many limitations soon became apparent. The theory includes basic substances that are not hydroxy compounds, does not provide for the amphoterism exhibited by many oxides and salts, and limits the field of acid-base reactions to aqueous solutions in spite of many known typical neutralization reactions in non-aqueous solutions.

These objections led to more or less conflicting theories: the protonic theory advanced by Brönsted and Lowry in 1923 and the older solvent system advanced by Franklin in 1905 and later extended. In terms of the then popular protonic concept, a base is any substance, molecule, or ion, which accepts a proton.

Words and Word-Combinations to Be Memorized

acidify, acidity, adequate, amphoteric, amphoterism, conductance, under consideration, dye, electrolyte, extend, feel, of importance, incident, incidentally, instead of, of interest, medium, objection, plant, provide, in question, role, smooth, solvent, under study, in spite of, typical

Ex. 5. Give the Russian equivalents for the following:

lead to, an interesting theory, during the infancy, define, thus, neutralize an acid, a plant dye, a smooth feeling, advance an idea, thereafter, an experimental approach, place emphasis, instead of, electrolytic conductance, propose a concept, a hydroxy compound, produce a salt, incidentally, although, an adequate theory, become apparent, exhibit amphoterism, in spite of

Ex. 6. Give the English equivalents for the following:

ограничивать, (не)водный раствор, несмотря на, вести к, протонная теория, расширить систему, с точки зрения той теории, любое

вещество, принимать протон, после открытия кислорода, в основном, состав вещества, теория кислотности, в начале XIX столетия, по этой теории, роль растворителя, ионизирующая среда, рассматриваемая идея, описать на основе поведения

Ex. 7. Fill in the blanks with articles where necessary.

1. In terms of ... protonic concept, ... base is ... substance which accepts ... proton. 2. The subject of ... acids and bases is one of ... most interesting in ... chemistry. 3. In ... 18th century Lavoisier advanced ... idea that oxygen was the acidifying principle of all acids. 4. Following ... discovery of oxygen ... emphasis was placed on ... composition of ... substances. 5. Many typical neutralization reactions occur in ... nonaqueous solutions.

Ex. 8. Give the synonyms for the following:

lead to, a series of, following (the discovery), advance an idea, thereafter, a concept, produce, exhibit

Ex. 9. Give the antonyms for the following:

long, the most popular, before, in the early 19th century, useful, extend, older

Ex. 10. Translate the sentences into Russian.

1. One of the most controversial problems in chemistry was that of acids and bases. 2. The development of the hydrogen theory of acidity and Faraday's studies of electrolytic conductance led to the water-ion theory. 3. The role of solvent as an ioinizing medium for acid-base reactions was pointed out. 4. The property in question was very useful for many reactions in aqueous solutions. 5. The theory was important, but its many limitations soon became apparent. 6. Analytical chemistry detects, purifies, and answers the questions "What?" and "How much?". 7. A liquid solution, the ocean, covers three-fourths of the earth's surface. 8. Any explosive substance must be handled with care. 9. Increase in pressure lessens the volume of a gas; increase in temperature increases the volume. 10. Calcium and silicon carbides are representatives of the direct union of carbon with metals and non-metals. 11. The word "chemical purity" is connected with the thought of absence of constituents other than the substance in question. 12. The atomic theory was John Dalton's great contribution to the world's knowledge. 13. The most important chemical property of oxygen is its acidity. 14. Pure sulphuric acid is a colourless, oily liquid about twice as heavy as water. 15. Atoms of the same element, with the same nuclear charge, but with different weights, are called isotopes of that element. 16. Science must always answer at least two questions — "What?" and "Why?". 17. No branch of science is broader in its scope than chemistry. 18. In a strict sense, no substance is entirely insoluble. 19. The then president of the Russian Academy of Sciences was M. V. Lomonosov. 20. One solution is said to be more concentrated or more dilute than another. 21. Water is the most widely

distributed compound. 22. The properties of plant dyes is the problem under consideration. 23. Another factor of great importance is the proper selection of reacting substances. 24. Let us consider the second condition. 25. Every year a great number of new discoveries are made in chemistry. 26. We consider it a step forward to develop the new technology of obtaning this material. 27. Both ways are possible. 28. The hypothesis under study may prove to be right. 29. It is not always possible to predict the far-off results. 30. The data below must be taken into account in this consideration.

Ex. 11. Translate the sentences into English without using a dictionary.

1. Рассматриваемая теория весьма противоречива. 2. В XVII столетии кислоты и основания описывали только на основе их поведения. 3. Считалось, что основания — это вещества, способные нейтрализовать кислоты и обладающие рядом других характерных свойств. 4. После открытия кислорода большое внимание стали уделять составу веществ. 5. Развитие водородной теории кислотности и изучение электролитической проводимости привело к созданию теории Аррениуса. 6. Для кислотно-основных реакций очень важна роль растворителя.

Ex. 12. Answer the following questions:

1. What substances were regarded as bases in the 17th century? 2. What important discoveries led to the water-ion theory? 3. What is a base according to Arrhenius? 4. What are the objections to the Arrhenius theory? 5. What theory was proposed in 1923?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

classification, principle, practical, equilibrium, discussion, nomenclature, neutralize, action, demonstrate, result, activity, electrical, dissociation, variation, scheme

Упр. 2. Проверьте, помните ли вы значения следующих слов; если нет, обратитесь к словарю:

perhaps, involve, vast, devote, sour, taste, reverse, essential, strength, consequence, apply, be responsible for, advance

Text 25 B

Прочтите текст про себя (контрольное время чтения — 3 минуты).

The Arrhenius Theory of Acids and Bases

There is perhaps no other class of equilibria as important as that involving acids and bases. As we continue the study of chemistry, we shall find that the classification "acid-base reaction" includes a vast number

of chemical changes, so that the principles and practical points are of very general use. Now we must devote some time to a discussion of nomenclature and classification of acids and bases.

The classification of substances as acids was at first suggested by their sour taste, and alkalis were taken as those substances that could reverse or neutralize the action of acids. It was thought also that an acid must have, as necessary constituent, the element oxygen, but in 1810 Davy demonstrated that hydrochloric acid contained only hydrogen and chlorine. Shortly thereafter the view was taken that all acids had hydrogen as an essential constituent.

An explanation of why acids had differing strengths was one of the important results of the Arrhenius ionic dissociation theory, developed between 1880 and 1890. The chemical activity and electrical conductivity of solutions of acids were taken to be consequences of their reversible dissociation into ions, one of which was H^+:

$$HCl = H^+ + Cl^-.$$

The fact that different acids had different strengths was explained as a result of a variation of the degree of dissociation. A similar scheme applied to the behaviour of bases, which were all thought to produce the hydroxyl ion in solution:

$$NaOH(s) = Na^+(aq) + OH^-(aq).$$

Thus, the proton was responsible for acidic properties, and the hydroxyl ion was responsible for basic properties.

While this point of view was a considerable advance in chemical theory, it led to certain difficulties. The first of these concerned the nature of the proton in aqueous solution, and the second had to do with the fact that substances which did not contain hydroxyl ion were capable of acting as bases.

Упр. 3. Передайте основное содержание текста в нескольких предложениях.

Упр. 4. Какое слово в тексте означает «главный, основной»?

Упр. 5. Найдите в тексте ответы на следующие вопросы:

1. Почему было трудно классифицировать вещества на кислоты и основания? 2. Что сначала считалось характерным признаком кислот? 3. Какой элемент считался необходимым компонентом кислот до открытия Дэви? 4. Какое важное обстоятельство, касающееся свойств кислот, объяснила теория Аррениуса? 5. Что является определяющим в поведении кислот и оснований?

Упр. 6. Закончите следующие предложения:

1. The subject of this text is ... 2. In 1810 it was showed ... 3. Hydrogen was considered to be ... 4. Different strengths of different acids were due to ... 5. Bases were thought to produce ...

Section III

Ex. 1. Make up short dialogues according to the example.

Example:
— What is the subject of the next lecture?
— Why should I know? (I've no idea.)
— Haven't you been at the previous lecture?

Ex. 2. Respond to the following statements:

1. The classification of substances into acids and bases has greatly changed. 2. The theory of ionic dissociation has played a great role in the development of chemistry. 3. The problem of nomenclature is still very important in chemistry.

Ex. 3. Give detailed answers to the questions.

1. What are the characteristic properties of acids? 2. What is the modern definition of a base? 3. What was the role of the theory by Arrhenius in the development of acid-base classification? 4. What is dissociation?

Ex. 4. Discuss the following topics:

1. The Problems of Classification in Chemistry.
2. The Evolution of the Theory of Acids and Bases.
3. The Present Concept of Acids and Bases.

Lesson 26

ГРАММАТИКА: Герундий и герундиальный оборот в функции определения. Причастие и причастный оборот в функции определения. Инфинитив после причастия II и слов *likely, sure, certain.*

Section I

Ex. 1. Practise your reading.

Liquid solutions provide an extremely convenient means of bringing together carefully measured amounts of reagents and of allowing them to react in a controlled manner.

Ex. 2. State what parts of speech the following words belong to:

press, pressing, pressure, compress, compressible, incompressible, compression

Ex. 3. Define the meanings of the word *respect* in the following sentences:

1. We *respect* our supervisor very much. 2. In this *respect* the two substances are alike. 3. Everybody has great *respect* to our lecturer in

general chemistry. 4. Selenium resembles sulphur in many *respects*. 5. My opinion is in no *respect* different from the author's. 6. With *respect* to their properties, halogens are of particular interest.

Ex. 4. Analyse the following sentence:

The most important problem of chemistry is that of explaining the behaviour of substances.

Text 26 A

Liquids and Solutions

Solids and gases represent the extreme states of behaviour of molecules. The liquid state can be thought of as an intermediate condition in which some of the properties found in either solids or gases are displayed. Liquids, like gases are isotropic and flow readily under applied stress, but like solids, they are dense, relatively incompressible, and have properties that are largely determined by the nature and strength of intermolecular forces. With respect to molecular order, liquids are substances considered to be intermediate between solids and gases. The fact that liquids are isotropic tells us immediately that they do not have the extended lattice structure and long-range order of solids. Yet, the density of a liquid is generally only 10% less than that of its solid phase; this must mean that the molecules in a liquid are packed together with some regularity, and do not exhibit the complete chaos associated with molecules in the gas phase.

One of the most important properties of liquids is their ability of acting as solvents. In the first place, liquid solutions provide an extremely convenient means of bringing together carefully measured amounts of reagents and of allowing them to react in a controlled manner. Second, the nature of the reactions which proceed and the speed at which they occur can be greatly influenced by the properties of the liquid solvent medium. Finally, the physical properties of solutions are interesting and important, because they can be used to determine molecular weights of dissolved substances and to study the nature and strength of forces between solvent and solute molecules.

One of the most engaging and absorbing features of the study of chemistry is the attempt to explain the behaviour of bulk matter in terms of molecular properties. Therefore, it is important to outline a molecular picture which will help us to understand and relate phenomena associated with the liquid state.

Words and Word-Combinations to Be Memorized

ability, absorb, bulk, complete, convenient, display, engage, generally, intermediate, intermolecular, lattice, a means, outline, reagent, range, with respect to, solute, strength

Ex. 5. Give the Russian equivalents for the following:

think of, display some properties, dense, intermolecular forces, with respect to, immediately, the lattice structure, the long-range order, mean, be packed together, provide a means of, carefully measured, proceed, finally, because, the behaviour of bulk matter, outline a picture, be associated with, the strength of forces

Ex. 6. Give the English equivalents for the following:

поведение молекул, жидкое состояние, либо... либо..., главным образом, порядок расположения молекул, занимать промежуточное положение между, на 10% меньше (больше), плотность жидкости, способность действовать в качестве растворителя, протекать с определенной скоростью, оказывать большое влияние, физические свойства растворов, определить атомный вес, растворенное вещество, растворитель, растворимое вещество

Ex. 7. Fill in the blanks with articles where necessary.

1. ... liquid state can be thought of as intermediate condition between ... solids and gases. 2. ... properties of liquids are determined by ... nature and strength of ... intermolecular forces. 3. ... density of ... liquid is generally only 10% less than that of ... solid. 4. Their ability of acting as ... solvents is one of ... most important properties of ... liquids. 5. It is important to outline ... molecular picture of ... liquid state.

Ex. 8. Give synonyms for the following:

think of, display, under stress, largely, immediately, little, allow, influence, feature, explain

Ex. 9. Give antonyms for the following:

incompressible, extend, long-range, less, convenient, be influenced by, most important

Ex. 10. Translate the sentences into Russian.

1. One should follow the proceeding reaction very carefully. 2. Selenium, an element belonging to the sulphur group, is as much nonmetal as metal. 3. Many factors mentioned determine the reaction rate. 4. There is a striking resemblance between some elements. 5. St. Petersburg University has its own publishing house. 6. The boiling point of water is accepted to be 100°C. 7. Some objections were found to the Arrhenius theory long believed to be true. 8. The most striking thing about hydrogen is its extreme lightness. 9. An acid is defined as a compound or an ion capable of liberating a proton. 10. Two or more atoms having identical nuclear charges but different numbers of neutrons are said to be isotopes. 11. Ores containing as little as 2 per cent or even less of copper or nickel are worth mining. 12. Bond formation involving

elements toward the middle of the periodic table occurs by the process of electron sharing. 13. There are a number of different procedures being used in qualitative analysis. 14. The calculation of hydrogen ion concentration in a solution containing a weak electrolyte is a difficult one for the average student first facing this problem. 15. Sulphur dioxide is more than twice as heavy as air and is one of the most easily liquefied gases known. 16. The term "heat" of combustion refers to the amount of heat liberated per mole of the substance burned. 17. Many industrial processes depend for their success upon the solubilities of the compounds formed. 18. The system of chemical symbols now used was proposed by the Swedish chemist Berzelius in 1818. 19. Fluorine, though for a long time known to exist, was not isolated until 1886. 20. There has been, since earliest times, an atomic hypothesis thought to be implied by the diffusion and the compressibility of gases on the one hand and by the symmetry of crystalline solids on the other. 21. The question of the composition of air long supposed to be one of the elements was solved only in the 18th century. 22. Dangerous bacteria in drinking water may be killed by small amounts of chlorine. 23. An element is represented by certain letters for ease in writing. This symbol stands for one atom of the element. 24. There are numerous methods for demonstrating the spectra of many of the elements. 25. In qualitative analysis there is usually greater difficulty in diagnosing the cations present than in recognizing the anions. 26. In English, we have the practice of naming chemical elements in Greek and Latin. 27. As a rule, there are several ways of preparing an element. 28. Mercury has the property, unusual for a metal, of being a liquid at room temperature. 29. The phenomena likely to arise during the experiment must also be taken into account. 30. The amount of the pure metal certain to be obtained for the ore can be calculated in the following way.

Ex. 11. Translate the sentences into English without using a dictionary.

1. Жидкое состояние, которое, как обычно думают, является промежуточным, проявляет некоторые свойства и твердых веществ, и газов. 2. Подобно твердым веществам, жидкости являются плотными. 3. Плотность жидкости, как обычно считают, только на 10% меньше плотности твердого вещества. 4. Способность быть растворителем — одно из основных свойств любой жидкости. 5. Представить себе молекулярное строение жидкости — одно из важнейших условий понимания природы ее свойств.

Ex. 12. Answer the following questions:

1. What are the main states of matter? 2. What factors determine the properties of liquids? 3. Is there any difference in the density of solids, liquids and gases? 4. Why are liquids usually thought of as solvents? 5. How can one understand the phenomena associated with the liquid state?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

kinetic, analyse, constantly, collision, observation, botanist, diameter, external, convection, manifestation, thermal, suspend, detect, individually, essence, execute, energy

Упр. 2. Проверьте, помните ли вы значения следующих слов; если нет, обратитесь к словарю:

substantial, motion, single, neighbour, reveal, tiny, incessant, random, cause, intrinsic, wealth, experience, surround, instant, displace, average

Text 26 B

Прочтите текст про себя (контрольное время чтения — 3,5 минуты).

A Kinetic Theory of Liquids

In a liquid, molecules are close to each other, and consequently the forces exerted on one molecule by its neighbours are substantial. Thus, the problem of analysing the motion of a single molecule is exceedingly difficult, for each is constantly in "collision", subject to the forces for as many as twelve nearest neighbours. What then can we say about molecular motion in liquids? One of the most revealing observations in this respect was made by the botanist Robert Brown in 1827. Brown discovered that very tiny particles (10^{-4} cm diameter) suspended in a liquid undergo incessant randomly directed motion. These motions occur without any apparent external cause such as stirring or convection, and are evidently associated with an intrinsic property of all liquids. A wealth of experimental observation has confirmed the idea of this Brownian motion being a direct manifestation of the thermal motion of molecules. When it is suspended in a liquid, a very small particle constantly experiences collisions with all the molecules surrounding it. If the particle is small enough, so few molecules will be able to collide with it, that at any particular instant the number striking it from one side may be different from the number striking it from the other sides; consequently, the particle will be displaced. Subsequently, another unbalance of collisional forces may occur, this time displacing the particle in a different direction. The great majority of these displacements are so small that they cannot be detected individually, but the motion which is observed is a result of many of the smaller random displacements. In essence, a Brownian particle is a "molecule" thought to be large enough to be observable, but small enough to execute observable random thermal motion.

Analysis of the motion of Brownian particles shows that their average kinetic energy is $^3/_2$ kT. Since each particle is to be considered as one of the molecules of the liquid we can conclude that the average kinetic energy of a molecule in a liquid is also $^3/_2$ kT — exactly the same as the kinetic energy of a gaseous molecule at the same temperature.

Упр. 3. Передайте основное содержание текста в нескольких предложениях.

Упр. 4. Какое слово в тексте означает «подвергаться воздействию»?

Упр. 5. Найдите в тексте ответы на следующие вопросы:

1. Почему трудно проследить движение одной молекулы жидкости? 2. Как в общем можно охарактеризовать движение молекул жидкости? 3. Как выглядит взаимодействие молекул в жидкости? 4. Как определяется средняя кинетическая энергия молекул жидкости?

Упр. 6. Закончите следующие предложения:

1. The molecules in a liquid are ... 2. To analyse the motion of a single molecule is difficult because ... 3. Brown discovered ... 4. Brownian motion is caused ... 5. The average kinetic energy of a molecule in a liquid is ...

Section III

Ex. 1. Make up short dialogues according to the example.

Example:

— What's the matter? (What's the trouble?)
— It is cold in this classroom.
— It can't be helped. You'd better go to room 312.

Ex. 2. Respond to the following statements:

1. The molecular motion in a liquid is not easy to describe. 2. Molecules in a liquid are arranged in a rather orderly manner. 3. The properties of the liquid solvent medium influence the speed of reactions occurring in this medium.

Ex. 3. Give detailed answers to the questions.

1. In what way are liquids and gases alike? 2. In what way do liquids resemble solids? 3. Why are the physical properties of solutions important? 4. What forces act between the molecules in a liquid?

Ex. 4. Discuss the following topics:

1. The Liquid State as an Intermediate State Between Solids and Gases.
2. Molecular Motion of Liquids.
3. Properties of Liquids.

Lesson 27

ГРАММАТИКА: Инфинитив и инфинитивный оборот в функции определения. Придаточное предложение в функции определения.

Section I

Ex. 1. Practise your reading.

It is often true that the most common concepts we use are the most difficult to define precisely.

Ex. 2. State what parts of speech the following words belong to:

solution, solute, solvent, soluble, solubility, solubilization, dissolve, dissolvable, dissolution, insoluble, solvation

Ex. 3. Define the meanings of the word *either* in the following sentences:

1. *Either* of these techniques may be used at high temperatures. 2. There are substances that cannot be clearly classified *either* as solutions or as mixtures. 3. A solution of soap in water has properties and composition which might be described as *either* inhomogeneous or homogeneous depending on the experiment we do. 4. Chlorine does not burn *either* in air or in pure oxygen. 5. *Either* of the elements of Group IA of the periodic table has a single electron in the outermost level. 6. This is a very useful reference book, I wish I had it in my library. — I haven't got it *either*. 7. There are three journals on the table, you may take *either* of them.

Ex. 4. Analyse the following sentence:

One must know the purity of a chemical to be used in the reaction.

Text 27 A

The Properties of Solutions

It is difficult to give a definition which tells clearly and briefly how solutions differ from mixtures and compounds, in spite of the fact that solutions are among the most familiar substances to be found in nature. However, it is often true that the most common concepts we use are the most difficult to define precisely. A solution is a homogeneous substance that has, over certain limits, a continuously variable composition. The word "homogeneous" sets a true solution apart from a mechanical mixture, for mixtures have macroscopic regions which have distinct and different composition and properties. The properties and composition of a solution are uniform, as long as the solution is not examined at the molecular level. There are substances, however, not to be clearly classified as solutions or

mixtures. A solution of soap in water has a cloudy appearance due to particles which consist of many soap molecules collected together. Such a substance has properties and composition which might be described as either inhomogeneous or homogeneous depending on the experiment to be done. Therefore, there is no sharp dividing line between mixtures and solutions.

The requirement that solutions have continuously variable composition distinguishes them from most compounds. However, many solid materials we commonly think of as compounds actually show variable composition. Cuprous sulphide and ferrous oxide are examples of compounds which might also be thought of as solutions. No matter how carefully we made our definitions of solution, mixture, and compound, we must expect to find certain substances not to be uniquely classified as one of these. There is no reason to expect nature to be cooperative and produce only substances which are easily classified, and since this is the case, the most useful definitions are often the shortest, rather than the most exhaustive.

Words and Word-Combinations to Be Memorized

actually, appearance, brief, briefly, this is the case, certain, classify, clearly, continuously, depending on, distinct, examine, familiar, ferrous, for, homogeneous, level, as long as, mechanical, no matter, precisely, requirement, to set, uniform, variable

Ex. 5. Give the Russian equivalents for the following:

to give a definition, to tell clearly and briefly, in spite of the fact, it is often true, the most common concepts, over certain limits, as long as, a cloudy appearance, the experiment to be done, a sharp dividing line, no matter how carefully, since this is the case

Ex. 6. Give the English equivalents for the following:

отличаться от, свойства растворов, вещества, которые можно найти в природе, точно определить, гомогенное вещество, переменный состав, исследовать на молекулярном уровне, четко классифицировать, в зависимости от эксперимента, нет оснований ожидать

Ex. 7. Fill in the blanks with articles where necessary.

1. It is rather difficult to give ... definition of ... solution. 2. ... word "homogeneous" sets ... true solution from ... mechanical mixture. 3. ... ferrous oxide is ... example of ... compounds we may consider as ... solution. 4. ... most useful definitions are often ... shortest. 5. At ... molecular level ... properties of ... solutions are not examined well enough.

Ex. 8. Give synonyms for the following:

precisely, distinct, different, examine, however, due to, consist of, many, do, material, commonly, actually, show, also, since

Ex. 9. Give antonyms for the following:

difficult, familiar, often, apart, different, short, most, certain, variable

Ex. 10. Translate the sentences into Russian.

1. Professor N was the first to prepare this kind of glass electrodes in our laboratory. 2. They stayed at the laboratory till 8 in the evening, because they had a lot of work to do. 3. There are two points to discuss. 4. This is the condition for everybody to observe. 5. There are some rules never to be forgotten. 6. Students who study chemistry must learn to do experiments. 7. Here is the room where chemicals are stored. 8. The need often arises in chemical research to measure the concentration of a solution with a high degree of precision. 9. A student about to begin an experiment must get his supervisor's permission. 10. The substance to be dissolved is called the solute. 11. There are a lot of problems for chemists to solve. 12. Acids are chemicals to be used carefully. 13. Not the least of D. I. Mendeleyev's services to chemistry was his publication of the first text-book of chemistry to be based throughout on the periodic system of classification. 14. John Dalton was by no means the first to speculate about an atomic theory. 15. Lavoisier was the first to realize the importance of the balance for chemical investigation. 16. D. I. Mendeleyev was the first Russian chemist to receive widespread recognition in the West during his lifetime. 17. The first element of the series of noble gases to be discovered was argon. 18. Oxygen is frequently chosen as one of the first elements to be studied in chemistry. 19. The rise of temperature gives more opportunity for the molecules to react. 20. There is usually a limit to how much solute a given volume of solvent can hold at a given temperature. 21. Compounds have properties that differ from those of the constituent elements. 22. We are living at a time when chemistry is used almost everywhere. 23. The periodic law D. I. Mendeleyev discovered created a new era in the history of chemistry. 24. The question whether a particular gas is lighter or heavier than air can be easily solved. 25. The state of a substance depends usually on the temperature and pressure it is subjected to. 26. The elements water is composed of are hydrogen and oxygen. 27. The first element we shall study in detail is oxygen. 28. It is recommended that water we use for drinking should be boiled. 29. It often happens that the necessary condition for the reaction to begin is the presence of a catalyst. 30. It is the usual laboratory practice that the potassium chlorate oxygen is to be produced from is placed in a vessel and heated.

Ex. 11. Translate the sentences into English without using a dictionary.

1. На вопрос о том, чем растворы отличаются от смесей, не всегда легко ответить. 2. Среди веществ, которые можно найти в природе, немало растворов. 3. Свойство гомогенности позволяет отличить истинный раствор от механической смеси. 4. Некоторые свойства растворов можно объяснить только на молекулярном уровне. 5. Нет оснований полагать, что вещества, которые мы находим в природе, всегда легко классифицировать.

Ex. 12. Answer the following questions:

1. Why is it difficult to give a definition of a solution? 2. Solutions are among the least known substances, aren't they? 3. What is usually considered as the main property of solutions? 4. In what way can you characterize a solution of soap in water? 5. Can one easily classify substances to be found in nature? 6. What definitions are the most useful?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

type, component, ethyl alcohol, zinc, metal, palladium, composition, really, contain, specify

Упр. 2. Проверьте, помните ли вы значения следующих слов; если нет, обратитесь к словарю:

just as, relationship, list, satisfy, treat, respectively

Text 27 B

Прочтите текст про себя (контрольное время чтения — 3 минуты).

Types of Solutions

Just as the variables, pressure, volume, and temperature, were used to describe the state or condition of pure gases, liquids, and solids, these and certain other variables must be used to describe solutions. First, some statement must be made about what chemically important constituents are present in the solution to be considered. A solution of ethyl alcohol (C_2H_5OH) and water really contains three elements: hydrogen, oxygen and carbon. However, because there is a quantitative relationship (the law of definite composition) between the amounts of carbon, hydrogen, and oxygen in ethyl alcohol, and a similar relationship between the amounts of hydrogen and oxygen in water, the composition of the solution can be completely described by specifying only the quantities of alcohol and water we used to prepare the solution. The substances used to specify the composition of a solution are known as *components*. One of the components, usually the one which is present in greatest quantity, is called the solvent; any other component is called a *solute*.

There are many possible types of solute-solvent pairs to be listed later. A mixture of two gases satisfies our definition of a solution, but the properties of gaseous mixtures are usually treated by Dalton's law and we shall not consider them here. Other types of solutions that are important are:

1) liquid in liquid;
2) solid in liquid;
3) gas in liquid;
4) liquid in solid;
5) gas in solid;
6) solid in solid.

Of these, the first three are common, and the last three, called *solid solutions*, occur less frequently. Mercury dissolved in zinc, hydrogen gas dissolved in palladium metal, and zinc dissolved in copper are examples of solutions in which liquid, gas and solid, respectively, are dissolved in solid. Apart from their mechanical properties, solid solutions do not differ greatly from the solutions of liquids.

Упр. 3. Передайте основное содержание текста в нескольких предложениях.

Упр. 4. Какое слово в тексте означает «помимо, кроме»?

Упр. 5. Найдите в тексте ответы на следующие вопросы:

1. Какие параметры использовались для описания физического состояния веществ? 2. Как определяется состав раствора? 3. Как описываются составные части раствора? 4. Что говорится о свойствах газовых смесей? 5. Какие типы растворов относят к твердым растворам? 6. Чем отличаются твердые растворы от жидких?

Упр. 6. Закончите следующие предложения:

1. Pressure, volume, temperature and certain other variables were used... 2. A solution of ethyl alcohol contains... 3. A solvent is... 4. A solute is... 5. The most common types of solutions are... 6. Solid solutions occur...

Section III

Ex. 1. Make up short dialogues according to the example.

Example:

— I don't like lectures on history.
— Why not?
— Prof. N speaks too quickly, I can't always follow him.

Ex. 2. Respond to the following statements:

1. There is a property that allows to distinguish a true solution. 2. The properties of solutions can be understood at the molecular level. 3. Both the solvent and the solute determine the properties of a particular solution.

Ex. 3. Give detailed answers to the questions.

1. What is considered to be a true solvent? 2. Can you give any examples of natural solvents? 3. What kinds of solutions do you know? 4. What is the most familiar type of solutions?

Ex. 4. Discuss the following topics:

1. The Characteristic Properties of Solutions.
2. Similarity and Difference Between Various Types of Solutions.
3. The Laws Describing the Properties of Solutions.

Part Five

THE ADVERBIAL MODIFIER

Lesson 28

ГРАММАТИКА: Обстоятельство. Существительное, наречие, герундий и герундиальный оборот в функции обстоятельства.

Section I

Ex. 1. Practise your reading.

As long ago as 1833, it was concluded that electrolysis took place through the transport of electricity by mobile charged particles.

Ex. 2. State what parts of speech the following words belong to:

electron, electronic, electricity, electric, electrical, electrify, electrochemistry, electrolyte, electrolysis, electrolytic, electrolyze, electrode, electrostatic

Ex. 3. Define the meanings of the word *number* in the following sentences:

1. There are a *number* of difficulties in the analysis of such systems. 2. My telephone *number* is 2530744. 3. Since the atomic *number* of hydrogen is 1, a single electron makes the atom electrically neutral. 4. An ion is regarded to have an electrovalence equal in *number* and sign to its charge. 5. The *number* of different kinds of molecules is enormous. 6. There are a *number* of steps which are common to all metallurgical processes involved in extracting a metal from its ores. 7. An idea able to explain or correlate a *number* of facts is called a hypothesis. 8. A great *number* of methods are now in use preparing silicon.

Ex. 4. Analyse the following sentence:

A good deal of success in the study of molecules in the gas phase prompted chemists to attempt to build up theories of solutions in an analogous way.

Text 28 A

Interactions in Electrolyte Solutions

In a solution of an electrolyte, it is often necessary to have a detailed knowledge of the species present. New ions or uncharged molecules resulting from interactions in the solution may behave quite differently from the constituent ions of the electrolyte. Some properties of the solutions will be profoundly affected, and the chemist, in order to understand these phenomena, will require to know the nature of the species present. There are a number of formidable difficulties in the analysis of such systems and, during the past forty years or so, a great deal of work has been done on the problem. The equilibrium properties of electrolyte solutions and the way in which ion-pair and complex formation can be detected and quantitatively studied are of primary importance. Although the application of new physical and chemical methods has produced significant contributions in this field, the information obtained from measurements of a system at equilibrium is to some extent limited, and in studying the phenomenon it is desirable to know the relevant kinetic parameters. Without this understanding, it is sometimes impossible to sketch the actual reaction mechanism by which the system approaches equilibrium. In general, we may regard the elucidation of the structure of an electrolyte solution as a difficult problem which requires as many independent lines of attack as possible.

A good deal of success in the study of molecules in the gas phase prompted chemists to attempt to build up theories of solutions in an analogous way. The classical theories regarded the solvent as merely providing space in which the solute particles moved and interactions between the ions and the solvent molecules were neglected. This assumption can be questioned on the basis of even the most elementary electrostatic considerations.

As long ago as 1833, both Faraday and Daniell concluded that electrolysis took place through the transport of electricity by mobile charged particles or ions which were discharged at the electrodes. These ions were produced simply by dissolving the electrolyte in the solvent and so the concept of bond-breaking in the molecules of electrolyte was first established. It is now realized that the energy required for such a process comes from the solvation of the ions. When the ions are introduced into solution, they interact with solvent molecules and a considerable heat of solvation may be involved. In order to understand such concepts, it is necessary to have a more detailed picture of the structure of the solvent molecules. Although non-aqueous solutions are of considerable interest, much of the work has been done in aqueous systems and these continue to be of paramount importance.

assumption, behave, conclude, considerable, a good deal of, a great deal of, detect, discharge, electricity, to some extent, interest, interaction, kinetic, merely, mobile, neglect, or so, parameter, primary, realize, result from, transport

Ex. 5. Give the Russian equivalents for the following:

a detailed knowledge, result from interactions, affect profoundly, during forty years or so, the equilibrium properties of solutions, produce a significant contribution, the relevant kinetic parameters, neglect some parameters, the energy comes from, be of considerable interest

Ex. 6. Give the English equivalents for the following:

взаимодействия ионов и молекул в растворе, влиять на свойства, чтобы понять эти явления, есть ряд трудностей, в течение последних сорока лет, изучать количественно, иметь первостепенное значение, получать информацию, ограничивать до некоторой степени, желательно знать, приближаться к равновесию, посредством переноса, подвижная заряженная частица, разорвать связь в молекуле, вводить в раствор, для того чтобы понять, неводный раствор

Ex. 7. Fill in the blanks with articles where necessary.

1. Sometimes it is necessary to have ... detailed knowledge about ... composition of ... solution under test. 2. It is desirable to know ... relevant kinetic parameters. 3. To understand ... structure of ... electrolyte solution is ... difficult problem. 4. It was concluded that ... electrolysis took place through ... transport of ... electricity by ... mobile charged particles. 5. Much of ... work has been done in ... aqueous systems.

Ex. 8. Give synonyms for the following:

a number of, a great deal of, do, produce, significant, information, obtain, study, actual, regard, analogous

Ex. 9. Give antonyms for the following:

present, new, uncharged, differently, with, difficult, many, move, more

Ex. 10. Translate the sentences into Russian.

1. It is often necessary to understand interactions in electrolyte solutions. 2. Some properties of the solutions will be profoundly affected. 3. In studying the properties of a solution, it is desirable to know its composition. 4. Interactions between the ions and the solvent molecules were sometimes neglected. 5. On returning, we shall continue our investigation. 6. Tomorrow you must finish it up. 7. In studying a foreign language, one must learn a lot of foreign words by heart. 8. You are not allowed to work in the laboratory without learning the safety instruction.

9. In the process of oxidation, the oxygen may be supplied by the air. 10. Solids dissolve in liquids only to a limited extent. 11. Pure water conducts the electric current hardly at all. 12. Existence of germanium was predicted by D. I. Mendeleyev in 1871. 13. Crystalline salts generally diffuse rapidly. 14. Due to crowding during formation or to erosion after formation, crystals are seldom perfect. 15. The chemical properties of ozone are similar to those of oxygen except for its being more active. 16. Silicon resembles carbon in forming a series of volatile hydrides. 17. In dealing with crystals, one first encounters ions — atoms or groups of atoms carrying electrical charges. 18. Nearly all mercuric compounds sublime on being heated in the closed vessel. 19. Two elements may combine spontaneously upon being mixed or under special conditions. 20. A catalyst is defined as a substance that will change the rate of a chemical reaction without itself being changed. 21. Carbon burns in oxygen on strong heating. 22. In studying chemistry, it is necessary to consider the nature of all kinds of matter. 23. By changing the temperature of the reacting substances or by changing the concentration (mass, per unit volume), the inherent tendency to react may be incresed or decreased. 24. Water, a compound of hydrogen and oxygen, is widely distributed over the earth. 25. Natural radioactivity was discovered by the French physicist Henri Becquerel (1851–1908) in 1896 just shortly after W. K. Roentgen's discovery of X-rays in 1895. 26. Different real gases have slightly different molar volumes. 27. The forces acting between atoms in a molecule are very strong, and those acting between molecules are weak. 28. The heat capacity of a substance at, say, 25°C is not necessarily the same as that measured at another temperature. 29. Covalency links are those commonly met with in carbon compounds. 30. Finely divided barium sulphate has a great tendency to absorb other ions from solutions.

Ex. 11. Translate the sentences into English without using a dictionary.

1. Для анализа раствора электролита необходимо знать, какие частицы находятся в нем. 2. Ионы электролита и новые ионы, получающиеся в результате взаимодействий в растворе, ведут себя поразному. 3. Большое внимание уделялось изучению растворов за последнее время. 4. Еще в 1833 году был сделан вывод, что электролиз происходит посредством переноса электричества подвижными заряженными частицами. 5. Как водные, так и неводные растворы представляют интерес для исследователей.

Ex. 12. Answer the following questions:

1. Why is it necessary to know the species present in solution? 2. What do the properties of electrolyte solutions depend on? 3. What knowledge helped chemists to build up theories of solutions? 4. What fundamental conclusion made it possible to investigate electrolyte solutions successfully? 5. What processes take place in electrolyte solutions?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

postulate, ionization, dissociate, equivalent, association, neutral, opposite, specific, base, concept, statistical, attraction, interpret, polarize, identical, potential, dielectric, deviation, ideal, mobility, approximation

Упр. 2. Проверьте, помните ли вы значения следующих слов; если нет, обратитесь к словарю:

infinite, dilution, conform, assume, decrease, increase, valid, owing to, remarkably, distribute, seek (+ инфинитив), ascribe

Text 28 B

Прочтите текст про себя (контрольное время чтения — 3,5 минуты).

Ionic Theories

About the mid-1880's, Arrhenius postulated in his ionization theory that (1) electrolytes are completely dissociated into their constituent ions in the limit of infinite dilution, (2) the equivalent conductance of the free ions is independent of concentration, (3) the equilibrium between the ions and the undissociated molecules conforms to the law of mass action. Thus, in the second postulate Arrhenius assumed that the decrease in conductivity with increasing concentration is due to the association of free ions to form neutral molecules. We now know that the original postulate is invalid since the mobility of the free ions decrease with increasing concentration owing to interaction between ions of opposite charge. In 1920, Brönsted's theory of specific ion interaction was based on the approximation that chemical interaction is limited to that between ions of opposite sign. By the reasoning given, it was shown that ions of the opposite charge are more likely to approach close to one another than are ions of the like charge, and this basic concept led to the considerable advances made by Brönsted in his own studies of mixed electrolyte solutions.

The first statistical theory of electrolyte solutions, the interionic attraction theory, was developed by Debye and Hückel in 1923 and its application has been remarkably successful in interpreting the behaviour of very dilute solutions. The ions are regarded as unpolarizable point charges distributed in a continuum possessing a dielectric constant identical with that of the pure solvent, and it is also recognized that ions group themselves a little closer around an ion of the opposite charge than they do around ions of the like charge. This leads to an ion atmosphere surrounding each ion in solution. From the theory, it is sought to calculate the average potential energy of a given ion in solution due to all the other ions, assuming the medium to have the dielectric constant of the pure solvent. In the argument strong electrolytes are assumed to be completely

dissociated into ions, and observed deviations from this ideal behaviour are then ascribed to electrical interactions between the ions.

Упр. 3. Передайте основное содержание текста в нескольких предложениях.

Упр. 4. Какие слова в тексте означают «закон действия масс»?

Упр. 5. Найдите в тексте ответы на следующие вопросы:

1. Каковы основные положения теории ионизации? 2. Чем, по мнению Аррениуса, объяснялось уменьшение проводимости при увеличении концентрации? 3. Какое допущение послужило основанием для теории Бренстеда? 4. Какая теория наиболее успешно объясняла поведение разбавленных растворов? 5. Как объясняется поведение ионов в растворе на основе теории Дебая и Хюккеля?

Упр. 6. Закончите следующие предложения:

1. The original postulate suggested by Arrhenius is invalid because... 2. Brönsted made considerable advances in... 3. The first statistical theory of electrolyte solutions was... 4. According to the theory developed by Debye and Hückel, an ion atmosphere surrounding each ion in solution is due to... 5. Using the theory by Debye and Hückel one can calculate...

Section III

Ex. 1. Make up short dialogues according to the example.

Example:

— I don't quite catch the difference between these theories.
— Look here, it's very simple. The main point is the difference in the behaviour of ions.
— Oh, now I see. Thanks a lot.

Ex. 2. Respond to the following statements:

1. A great deal of work has been done on the problem of interactions in electrolyte solutions. 2. Theories of solutions are in some respects similar to theories of gases. 3. The problem of electrolysis has interested chemists for almost two centuries.

Ex. 3. Give detailed answers to the questions.

1. What do the properties of electrolyte solutions depend on? 2. Whose contribution to the development of the theory of electrolyte solutions was of considerable importance? 3. What fundamental ideas have been developed at the department of the theory of solutions of the University of St. Petersburg?

Ex. 4. Discuss the following topics:

1. The Behaviour of Electrolyte Solutions.
2. The Development of Ideas concerning Electrolyte Solutions.
3. Generally Accepted Principles Concerning Electrolyte Solutions.

Lesson 29

ГРАММАТИКА: Причастие и причастный оборот в функции обстоятельства. Независимый причастный оборот.

Section I

Ex. 1. Practise your reading.

The temperature remaining constant, the fraction of liquid molecules with enough kinetic energy to evaporate remains the same, and evaporation continues.

Ex. 2. State what parts of speech the following words belong to:

vapour, vaporous, vaporable, vaporization, vaporizability, vaporize, evaporate, evaporation, evaporative, evaporator

Ex. 3. Define the meanings of the word *until* in the following sentences:

1. Continue heating *until* the solution evaporates completely. 2. Don't do anything *until* I come. 3. Day after day he works *until* night. 4. Evaporation continues *until* no liquid is left. 5. It was not *until* the atomic theory was established that chemistry became a nature science founded on scientific principles. 6. It was not *until* March 1869 that the paper on the periodic table was presented at the meeting of the Russian chemical society. 7. Let us wait for him *until* 9 o'clock and if he doesn't come, we shall go away. 8. There is no suitable technique *until* now.

Ex. 4. Analyse the following sentence:

The temperature remaining constant, evaporation continues at a constant rate.

Text 29 A

Liquid-Vapour Equilibrium

A liquid of relatively low boiling temperature, when placed in a container open to the atmosphere, will eventually evaporate entirely. Remembering that molecules in the liquid are "bound" by attractive forces to their neighbours, we might ask why some are able to overcome these forces and leave the liquid spontaneously. The answer lies in a consideration

of the possible magnitudes of molecular kinetic energies, for these, as we have already mentioned, range from very low to very high values, and are distributed according to the Maxwell-Boltzmann law. Therefore, even if the average potential energy which binds the molecules to the liquid is substantial, there are always some molecules which have enough kinetic energy to overcome the binding forces and enter the vapour. According to the Maxwell-Boltzmann law, the fraction of the molecules which have kinetic energies greater than some minimum value ε, the value required for the molecules to leave the liquid, is proportional to the Boltzmann factor, $e^{-\varepsilon/kT}$. Therefore, the temperature remaining constant, the fraction of liquid molecules with enough kinetic energy to evaporate remains the same, and evaporation continues. The vessel being open to the atmosphere, vapour molecules are swept away, and evaporation continues until no liquid is left.

Now, let us analyse what happens when a liquid is placed in a closed evacuated container. Immediately, the liquid starts to evaporate at a rate which is primarily determined by the fraction of molecules which have enough kinetic energy to overcome attractive forces and leave the surface. Initially, the rate of condensation is zero, there being no molecules in the vapour. As long as the temperature stays constant, evaporation continues at a constant rate, and the number of molecules in the vapour phase increases. Consequently, the rate of condensation starts to increase, for as the pressure of the vapour grows, the number of gas molecules which collide with and reenter the liquid surface also increases.

The time dependence of the evaporation and condensation rates is worth considering. While growing, the condensation rate eventually becomes equal to the rate of evaporation. At this time, the number of molecules which enter and which leave the vapour per unit time is the same, and, consequently, the pressure of the vapour stops increasing and remains constant. If the system is left undisturbed at a fixed temperature, evaporation and condensation continue at equal rates, and the pressure of the vapour remains unchanged. This, then, is a situation of equilibrium between the two phases. Note particularly that at equilibrium, evaporation and condensation do not stop, but that the constancy of the equilibrium vapour pressure is a consequence of these opposing processes proceeding at *equal* rates. Thus we say that phase equilibrium is *dynamic* in nature.

Words and Word-Combinations to Be Memorized

analyse, attractive, bind, constant, dependence, initial, magnitude, note, primarily, proportional, situation, spontaneous, substantial, it was not until... that, not until, vessel, zero

Ex. 5. Give the Russian equivalents for the following:

evaporate, entirely, overcome the forces, leave the liquid, the magnitude of the energy, range from... to, substantial, overcome the binding forces, be proportional to, remain the same, start immediately, the dependence is

worth considering, become equal to, per unit time, consequently, at a fixed temperature, remain unchanged, opposing processes

Ex. 6. Give the English equivalents for the following:

относительно низкая температура, поместить в сосуд, преодолеть силы притяжения, самопроизвольно, средняя потенциальная энергия, открытый сосуд, давайте проанализируем, начинать испаряться, первоначально, с постоянной скоростью, давление пара растет, положение равновесия

Ex. 7. Fill in the blanks with articles where necessary.

1. Let us analyse what happens when ... liquid is placed in ... closed evacuated container. 2. As long as ... temperature remains constant, ... evaporation continues at ... constant rate. 3. As ... pressure of ... vapour grows, ... number of ... gas molecules returning to ... liquid also increases. 4. ... time dependence of ... evaporation and condensation rates should be considered. 5. At equilibrium, ... evaporation and condensation do not stop.

Ex. 8. Give synonyms for the following:

magnitude, mention, substantial, fraction, remain, place, primarily, initially, increase, equal

Ex. 9. Give antonyms for the following:

low, open, leave, minimum, the same, continue, container, immediately, start, also, consequently

Ex. 10. Translate the sentences into Russian.

1. Heating the substance, one must be very attentive. 2. While moving, molecules collide with each other. 3. When at the laboratory, one must observe safety rules. 4. Our lecturer being ill, we had no lecture yesterday. 5. Our assumption confirmed, we could continue the experiment. 6. The lecture being over, we shall have a long break for dinner. 7. If present in air in larger amounts than 1 in 20,000 by volume, ozone is irritant and poisonous. 8. Practically, all acids when pure are polar molecular structures. 9. Having made a number of experiments with calcium and sulphuric acid at the temperature of 40°C, the Russian engineer Petrov was the first to put forward the problem of chemical activation. 10. One must be very careful when heating potassium chlorate. 11. Any element when combining with oxygen forms an oxide. 12. While dealing with chemicals in a laboratory, one can't do without such apparatus as funnels, beakers and so on. 13. Once discovered, the periodic system of the elements received much scientific attention. 14. Unless otherwise stated, volumes of gases always refer to standard conditions of temperature and pressure. 15. No substance can be considered chemically dry unless specially treated. 16. Large pieces of sodium may produce dangerous explosions if placed

on water. 17. Sodium hydroxide is prepared industrially by two general methods, the oldest being the reaction of sodium carbonate and calcium hydroxide. 18. Hydrogen peroxide being added to an acidified solution of potassium permanganate, bubbles of gas are evolved, the gas evolved being oxygen. 19. The formula of a compound being known, we can calculate its molecular weight. 20. The liquid state being intermediate between the solid and gaseous state, the properties of the liquids show similarities to those of both solids and gases. 21. Cobalt and nickel are much more resistant to atmospheric oxidation than iron, with nickel being especially resistant. 22. Considered from this point of view, the reaction mechanism seems to depend only on the following three factors. 23. Having analysed the data, the author found that they were in agreement with the theory. 24. Having been heated to 100°C, water began to boil. 25. Having finished the experiment, we must process the data. 26. Except where otherwise stated, the measurements were taken at room temperature. 27. Other things being equal, pressure grows proportionately to the temperature. 28. Having discovered the law of periodicity of the chemical elements, Mendeleyev made his greatest contribution to the development of chemistry. 29. Studying the properties of any substance, the chemist has to perform a number of experiments. 30. Lavoisier (1745–1794), believing oxygen to be a constituent of all acids, gave it the name *oxygen* (Greek: *acid-former*).

Ex. 11. Translate the sentences into English without using a dictionary.

1. Если жидкость с низкой температурой кипения находится в открытом сосуде, она в конце концов полностью испарится. 2. Молекулы жидкости связаны с соседними молекулами силами притяжения. 3. Некоторые молекулы обладают достаточной кинетической энергией для того, чтобы преодолеть силы связывания и перейти в пар. 4. При прочих равных условиях, пока температура остается постоянной, испарение продолжается с постоянной скоростью. 5. Если жидкость находится в закрытом сосуде, необходимо рассмотреть процесс конденсации.

Ex. 12. Answer the following questions:

1. What happens with a liquid if it is placed in an open container? 2. What forces act between the molecules in a liquid? 3. Under what conditions can some molecules leave the liquid? 4. What happens if a liquid is placed in a closed evacuated container? 5. What does the rate of condensation depend upon? 6. What situation is called equilibrium between the liquid and vapour phases?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

normal, initiation, guarantee, final, introduce, agent, porous, ceramic

Упр. 2. Проверьте, помните ли вы значения следующих слов; если нет, обратитесь к словарю:

sensitive, raise, bubble, exert, hence, reach, violence, exceed, avoid, evolve

Text 29 B

Прочтите текст про себя (контрольное время чтения — 3,5 минуты).

Temperature Dependence of Vapour Equilibrium

Experimental measurements show that the equilibrium vapour pressure of a liquid increases as the temperature increases. In the temperature range in which the vapour pressure is small, it is relatively insensitive to the temperature, but the vapour pressure grows at an increasing rate as the temperature is raised. The temperature at which the equilibrium vapour pressure becomes equal to 1 atm is called the normal boiling temperature, or *the boiling point*. In the boiling process, bubbles of vapour form throughout the bulk of the liquid. In other words, evaporation occurs *anywhere* in the liquid, not just at the upper surface. The reason that this occurs only when the vapour pressure equals the atmospheric pressure is easy to understand. In order for a bubble to form and grow the pressure of the vapour inside the bubble must be at least equal to the pressure exerted on it by the liquid. This, in turn, is equal to the pressure of the atmosphere plus the very small pressure due to the weight of the liquid above the bubble. Therefore, bubble formation and boiling occur only when the vapour pressure of the liquid is equal to the pressure of the atmosphere.

The initiation of a bubble in the bulk of a pure liquid is a very difficult process, since it requires that many molecules with kinetic energies greater than that required for vaporization must be close to one another. Hence, the fact that the liquid reaches the boiling temperature is no guarantee that boiling will occur. If it does not, continued addition of heat will cause the liquid to become superheated, that is, to reach a temperature greater than its boiling point. When finally occurring in a superheated liquid, the bubble formation proceeds with almost explosive violence, because the vapour pressure in any bubble formed greatly exceeds atmospheric pressure, the bubbles tending to expand rapidly. Such violent boiling can be avoided introducing agents which initiate bubbles in the liquid as soon as the boiling temperature is reached. Porous pieces of ceramic material which evolve small bubbles of air into which evaporation can occur serve very well in this application.

Упр. 3. Передайте основное содержание текста в нескольких предложениях.

Упр. 4. Какие слова в тексте означают «в свою очередь»?

Упр. 5. Найдите в тексте ответы на следующие вопросы:

1. In what way does the vapour pressure change at equilibrium? 2. What is the normal boiling temperature? 3. Under what conditions

does the initiation of a bubble in the bulk of a pure liquid occur? 4. When does the liquid become superheated? 5. What are porous pieces of ceramic material used for?

Упр. 6. Закончите следующие предложения:

1. The vapour pressure grows at an increasing rate... 2. The boiling point of a liquid is... 3. Bubble formation and boiling occur only when... 4. The fact that the liquid reaches the boiling temperature is no guarantee that... 5. Violent boiling can be avoided...

Section III

Ex. 1. Make up short dialogues according to the example.

Example:

— What kind of equipment do students learn to use in your lab?
— First of all, we learn to handle test-tubes, beakers, funnels, burners and so on.
— It's quite natural. You can't do without all these things if you are a chemist.

Ex. 2. Respond to the following statements:

1. The processes of evaporation in an open container and in a closed one are not the same. 2. It is interesting to consider the time dependence of the evaporation and condensation rates, isn't it? 3. One can easily describe what happens in a liquid when it begins boiling.

Ex. 3. Give detailed answers to the questions.

1. In what way does vaporization proceed? 2. What is liquid-vapour equilibrium? 3. How does temperature influence the vapour pressure?

Ex. 4. Discuss the following topics:

1. The Vaporization Process.
2. The Phase Equilibrium.
3. Factors Influencing the Vapour Pressure.

Lesson 30

ГРАММАТИКА: Инфинитив и инфинитивный оборот в функции обстоятельства. Придаточные обстоятельственные предложения.

Section I

Ex. 1. Practise your reading.

It is a matter of common experience that the capacity of a solvent to dissolve in a given solute is often limited.

Ex. 2. State what parts of speech the following words belong to:

mix, mixture, mixing, mixer, mixed, mixable, miscible, miscibility

Ex. 3. Define the meanings of the word *case* in the following sentences:

1. We shall first limit ourselves to *the case* of ideal solutions. 2. In *case* a solute and its solution reach equilibrium, a saturated solution may result. 3. A homogeneous material has the same properties throughout, it is far from *the case* with heterogeneous materials. 4. According to their properties the halogens should be very reactive, and this is really *the case*. 5. Reacting with oxygen, an element forms an oxide in which *case* the process is known as oxidation. 6. Phosphorus is very active chemically, but this is not *the case* with nitrogen. 7. During oxidation, heat and light are often liberated, in this *case* the process is called combustion. 8. It was supposed that oxidation of copper could be prevented under low temperatures, and such was *the case*. 9. One cannot expect that gas molecules would always behave in the same way as is *the case* with liquid molecules. 10. If there are several ways of doing something, one should know all of them so that he could choose anyone, as *the case* may be.

Ex. 4. Analyse the following sentence:

There are many pairs of substances which can be mixed in any proportions to form homogeneous solutions.

Text 30 A

Solubility

While there are many pairs of substances which, like water and ethyl alcohol, can be mixed in any proportions to form homogeneous solutions, it is a matter of common experience that the capacity of a solvent to dissolve a given solute is often limited. When a solvent placed in contact with an excess of solute attains and maintains a constant concentration of solute, the solute and solution are at equilibrium, and the solution is said to be saturated. The solubility of a substance in a particular solvent at a given temperature is the concentration of the solute in the saturated solution. In other words, the solubility of a solute is the dissolved concentration characteristic of the state of equilibrium between the solute and the solution. It is difficult to overemphasize the importance of the concept of solubility to chemistry; it is the basis of innumerable laboratory and industrial processes that prepare, separate, and purify chemicals, and is the controlling factor in a variety of geological and other natural phenomena. The solubility of a substance in a particular solvent is controlled principally by the nature of the solvent and solute themselves, but also by the conditions of temperature and pressure. To analyse these factors, we shall first limit ourselves to the case of ideal solutions.

The liquids that form an ideal solution are always miscible in any proportions and, thus, have infinite solubility in each other. The reason for this is easy to see if we recall two facts. First, limited solubility and a saturated solution result only when a solute and its solution reach equilibrium. Second, the equilibrium state is a compromise between a natural tendency toward minimum energy and maximum molecular chaos. Now, the mixing of two ideal liquids is always accompanied by an increase in entropy or molecular chaos, because in the solution, the solute molecules are spread randomly throughout the solvent, rather than being nearly closest packed as they are in the pure solute. That is, even if we could locate one solute molecule in solution, we could not predict what the identity of its nearest neighbours was, as we could, if the molecule were in the pure solute phase. Consequently, the solution has a higher entropy than the pure solvent and solute, and the tendency toward maximum molecular chaos favours the mixing of the two liquids. Moreover, the fact that there is no energy change in the mixing process means that the tendency toward minimum energy does not restrict the solution process. Consequently, the two liquid components of an ideal solution can mix in any proportion.

Words and Word-Combinations to Be Memorized

as is the case with, as the case may be, in case, in which case, it is far from the case, it is not the case with, such is the case, a chemical, contact, emphasize, excess, experience, be a matter of common experience, favour, ideal, identity, maintain, maximum, natural, purify, result, saturate, saturated, solubility, spread, themselves, toward(s), a variety of

Ex. 5. Give the Russian equivalents for the following:

mix in any proportions, the capacity to dissolve a solute, place in contact with, the solubility in a particular solvent, purify chemicals, be a controlling factor, a variety of phenomena, be controlled by the nature of the solvent and solute, be miscible in any proportions, be spread randomly throughout the solvent, be close packed, moreover, restrict the process, emphasize the importance

Ex. 6. Give the English equivalents for the following:

общеизвестно по опыту, что...; ограниченная способность, избыток растворимого вещества, быть в равновесии, в насыщенном растворе при данной температуре и давлении, другими словами, значение концепции растворимости для химии, во множестве природных явлений, ограничиться случаем, идеальный раствор, достигать равновесия, сопровождаться увеличением температуры, а не..., даже если, нет изменения энергии

Ex. 7. Fill in the blanks with articles where necessary.

1. Substances like ... water and ... ethyl alcohol can be mixed in any proportions. 2. ... capacity of ... solvent to dissolve ... given solute is often limited. 3. ... solubility of ... substance in ... particular solvent at ... given temperature is its concentration in ... saturated solution. 4. It is difficult to overemphasize ... importance of ... concept of ... solubility to ... chemistry. 5. We shall first analyse ... case of ... ideal solution.

Ex. 8. Give synonyms for the following:

capacity, limit, place, principally, be accompanied by, because, toward, consequently

Ex. 9. Give antonyms for the following:

constant, saturated, at first, always, easy, decrease, near, minimum, seldom, limited

Ex. 10. Translate the sentences into Russian.

1. The capacity of a solvent to dissolve a given solute is often limited though there are many pairs of substances which can be mixed in any proportions. 2. In order to control our environment, the first purpose of science must be to study and understand it. 3. To answer the question "What are the uses of sulphuric acid?" fully, one would need to write a book. 4. The alkali metals are usually stored in oil so as to exclude air. 5. In order for two molecules to react with each other, they must, first of all, be in the presence of each other. 6. For hydrogen to be obtained from water, electrolysis may be used. 7. Sodium is a white metal soft enough to be easily cut with a knife and light enough to float on water. 8. The minerals in which aluminium occurs, are too numerous to recite. 9. The vapour pressure of many pure liquids or solids is very low, in fact, so low as to be immeasurable by direct means. 10. The catalytic substance can be recovered unchanged after the reaction is completed. 11. As the temperature is raised, the rate of evaporation increases. 12. Once the validity of a hypothesis has been tested by all possible experiments and is found to be in harmony with all the facts, it assumes the status of a theory. 13. Whenever a chemical reaction occurs, an energy change takes place. 14. Liquid bromine should be kept in well-stopped bottles, as this element is poisonous. 15. The discovery of silicon was an important event in chemistry, for the properties of the element were found to be very close to those predicted by D. I. Mendeleyev on the basis of his periodic law. 16. Where the current enters or leaves the liquid, there are evidences of chemical action having taken place. 17. If sulphur trioxide is thrown into water, it will dissolve with the evolution of much heat. 18. If there were no order in the way in which atoms of different elements combine to form the molecules and crystals of compounds, it would be necessary for us to memorize one by one the formulas of thousands of substances. 19. If we had chosen the second oxide, the valence of sulphur and, therefore, its equivalent weight

would have been different. 20. With a few exceptions the molten metals are completely soluble in one another, so that it is possible to make solutions of all concentrations. 21. True salts are always ionic, whether they are in solution or in their crystalline forms. 22. Fluorine and hydrogen combine violently even in the dark, provided a trace of moisture is present. 23. Strange as it may seem, the reaction may proceed both ways. 24. Important as the problem of solubility may be, we shall not consider it now. 25. Let us consider any factors lest anything may be omitted. 26. Unless the electron microscope had been used, it would not have been possible to obtain these results. 27. Were the parameters maintained, the reaction would go to completion. 28. Physics and chemistry are so closely related that textbooks of these two subjects contain much in common. 29. Many oxides are found to combine with acids to form salts and water. 30. Carbon monoxide cannot properly be described as either a basic or an acidic oxide, inasmuch as it does not react with water.

Ex. 11. Translate the sentences into English without using a dictionary.

1. Различные вещества обладают различной способностью растворяться в данном растворителе. 2. Растворимость вещества — это его концентрация, характерная для состояния равновесия между растворимым веществом и раствором. 3. Понятие растворимости представляет собой основу для многочисленных лабораторных и промышленных процессов. 4. Растворимость зависит как от природы самих растворителя и растворяемого вещества, так и от условий процесса. 5. Два жидких компонента идеального раствора могут смешиваться в любой пропорции.

Ex. 12. Answer the following questions:

1. In what way can the capacity of a solvent to dissolve a given solute be characterized? 2. What state is regarded as equilibrium between the solute and solution? 3. What is usually called the solubility of a substance in a particular solvent? 4. What is the importance of the concept of solubility? 5. What is an ideal solution?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

convert, hypothetical, contract, absorption, mole, entropy, compromise, deduce, argument, energetically, chaos, generalization, rationalize, accompany, anticipate

Упр. 2. Проверьте, помните ли вы значения следующих слов; если нет, обратитесь к словарю:

melt, in turn, stage, involve, represent, extend, evolution, infinitely, likewise, markedly, subtle

Text 30 B

Прочтите текст про себя (контрольное время чтения — 3,5 минуты).

Nonideal Solutions

Consider a solid substance dissolving in a liquid solvent. The solid is such that when melted, it is converted to a liquid that, in turn, can form an ideal solution with the solvent. The dissolution of the solid can be pictured as occurring in two hypothetical stages:

solid solute → liquid solute → solute in solution.

The second of these steps does not involve any energy change, for the solution formed is ideal. In contrast, the first step does involve the absorption of energy in the amount $_{\Delta}H_{fus}$ per mole of solute. Consequently, while the tendency toward maximum entropy favours the dissolution of the solid, the tendency toward minimum energy favours the solid remaining undissolved. Therefore, the solubility of the solid is limited, and a saturated solution which represents the best compromise between maximizing entropy and minimizing energy is formed. Since $_{\Delta}H_{fus}$ is related to the strength of attractive forces between solute molecules, we can deduce that the magnitudes of these same forces determine the solubility of the solid in ideal solutions.

By using some care, we can extend our arguments to nonideal solutions. Two liquids which mix with the evolution of heat will be infinitely soluble in each other, for both energy and entropy effects favour their mixing. Two liquids which mix with the absorption of heat may have limited solubility in each other, for if the mixing process is energetically unfavourable, the tendency toward maximum molecular chaos may or may not be sufficient to allow the liquids to mix in all proportions. Likewise, the solubility of a solid is likely to be small if it enters the solution only with considerable absorption of heat. On the other hand, if the dissolution of the solid is accompanied by evolution of heat, the solubility of the solid may be quite high. Even with these generalizations it is difficult to predict or even rationalize qualitatively the solubilities of substances that form markedly nonideal solutions, for the energy and entropy changes that accompany the mixing of strongly irreacting molecules are subtle and difficult to anticipate.

Упр. 3. Передайте основное содержание текста в нескольких предложениях.

Упр. 4. Какое слово в тексте означает «представить себе»?

Упр. 5. Найдите в тексте ответы на следующие вопросы:

1. What hypothetical steps can be pictured when a melted solid is dissolved? 2. At what stage does the energy change take place? 3. Why is the solubility of the solid limited? 4. What two liquids will be infinitely soluble in each other? 5. When will the solubility of the solid be high?

Упр. 6. Закончите следующие предложения:

1. The magnitudes of the attractive forces determine... 2. Two liquids will be infinitely soluble in each other if they mix with... 3. Two liquids mixing with the absorption of heat may have... 4. It is difficult to predict... 5. If the dissolution of the solid is accompanied by evolution of heat...

Section III

Ex. 1. Make up short dialogues according to the example.

Example:

— Why didn't you come to the seminar yesterday?
— Because I've missed Dr. N's lecture.
— I see. Having missed the lecture, you couldn't take part in the discussion.

Ex. 2. Respond to the following statements:

1. The process of dissolving a solid in a liquid is different from the process of dissolving a liquid in a liquid. 2. Solubility depends on a number of factors. 3. One can easily predict the solubility of a particular solute in a given solvent.

Ex. 3. Give detailed answers to the questions.

1. What is solubility? 2. What does the solubility of a substance depend on? 3. What is the difference between an ideal and nonideal solution?

Ex. 4. Discuss the following topics:

1. Solubility of Liquids.
2. Solubility of Solids.
3. Factors Influencing Solubility.

Part Six

PARENTHESES

Lesson 31

ГРАММАТИКА: Вводные члены предложения. Инфинитив и причастие в функции вводного члена предложения.

Section I

Ex. 1. Practise your reading.

The terms "oxidation" and "reduction" now are applied to reactions in which neither oxygen nor hydrogen are involved.

Ex. 2. State what parts of speech the following words belong to:

oxide, oxidable, oxidability, oxidant, oxidate, oxidation, oxidative, oxidic, oxidize, oxidizable, oxidizability, oxidizer, oxygen, oxygenate, oxygenize, hydroxide, dioxide

Ex. 3. Define the meanings of the word *put* in the following sentences:

1. Please, *put* this book on the shelf. 2. *Put* down the apparatus, never hold it in your hands during operation! 3. The idea was *put* forward that ozone is essential in protecting life on the Earth. 4. To *put* the instrument into operation press the red button. 5. It seems to me that this is a utopian idea and it can never be *put* into practice. 6. To *put* it in another way, these two terms mean the same. 7. Never *put* off till tomorrow what you can do today.

Ex. 4. Analyse the following sentence:

Strictly speaking, we cannot say that we know everything about oxidation.

Text 31 A

Oxidation and Reduction

Generally speaking, the simple meanings of these terms are that oxidation is the addition of oxygen to a substance and reduction is the

removal of oxygen. Needless to say, hydrogen seems to be the chemical opposite of oxygen (the two elements combine readily, and are evolved at opposite electrodes during electrolysis). Removal of hydrogen is, therefore, similar to the addition of oxygen, and addition of hydrogen is similar to the removal of oxygen. Fuller meanings of the two terms are therefore: Oxidation is the addition of oxygen to, or removal of hydrogen from, a substance. Reduction is the removal of oxygen from, or addition of hydrogen to, a substance.

$2SO_2 + O_2 \rightleftharpoons 2SO_3$	(oxidation of SO_2; addition of oxygen)
$PbO + H_2 \rightarrow Pb + H_2O$	(reduction of PbO; removal of oxygen)
$Cl_2 + H_2 \rightarrow 2HCl$	(reduction of Cl_2; addition of hydrogen)
$H_2S + Cl_2 \rightarrow S\downarrow + 2HCl$	(oxidation of H_2S; removal of hydrogen)

The terms now are applied to reactions in which neither oxygen nor hydrogen are involved. To take an example, the change of ferrous oxide to ferric oxide is, obviously, an oxidation; similarly, we can regard the change of any ferrous compound to a ferric compound as an oxidation (and a change of ferric to ferrous as a reduction): $4FeO + O_2 \rightarrow 2Fe_2O_3$; $FeCl_2 + Cl_2 \rightarrow 2FeCl_3$. Note that the valency of the metal increases during oxidation.

Metals and hydrogen form positive ions (e. g., Na^+ and H^+) and are, therefore, called electropositive. Non-metals and acid radicals are electronegative as they form negative ions (e. g., O^{2-}, SO_4^{2-}). Putting it another way, more complete definitions of the two terms are:

Oxidation is the addition of any electronegative element or radical to, or removal of any electropositive element or radical from, a substance. Reduction is the opposite.

An oxidizing agent is a substance which brings about oxidation, a reducing agent is a substance which brings about reduction.

Oxidizing agents include: oxygen, hydrogen peroxide, nitric acid, sulphuric acid, chlorine, potassium permanganate, potassium dichromate.

Reducing agents include: hydrogen, carbon, carbon monoxide, sulphur dioxide, hydrogen sulphide, ammonia, and most metals and non-metals. The equations for the oxidation of ferrous chloride are:

$$2FeCl_2 + Cl_2 \rightarrow 2FeCl_3;$$

ionically: $2Fe^{2+} + Cl_2 \rightarrow 2Fe^{3+} + 2Cl^-$.

As already mentioned, the oxidation involves a change of ferrous ion to ferric, it occurs by loss of an electron (e). And oxidation of chlorine to chloride ions takes place by gain of electrons:

$$Fe^{2+} - e \rightarrow Fe^{3+} \text{ (oxidation);}$$
$$Cl_2 + 2e \rightarrow 2Cl^- \text{ (reduction).}$$

To summarize, oxidation is the removal of electrons from a substance. Reduction is the addition of electrons to a substance.

An oxidizing agent is a substance that accepts electrons. A reducing agent is a substance that supplies electrons.

(Remember the word ORE — Oxidation is Removal of Electrons.)

Words and Word-Combinations to Be Memorized

agent, e. g., evolve, generally speaking, loss, meaning, monoxide, needless to say, neither... nor, non-metal, opposite, permanganate, peroxide, put into operation, put into practice, put it (in) another way, put off, removal, remove, say nothing of, seem, summarize

Ex. 5. Give the Russian equivalents for the following:

the meaning of the term, needless to say, combine readily, a fuller meaning, add to, remove from, apply to, take an example, obviously, regard as, be the opposite, bring about oxidation, involve a change, by gain of electrons, by loss of electrons, accept, supply

Ex. 6. Give the English equivalents for the following:

вообще говоря, легко соединяться, выделяться на электроде, быть похожим на, следовательно, применять к реакции, ни... ни..., например, подобным образом, заметим что, увеличивать валентность, иными словами, полное определение, азотная кислота, сульфид водорода, аммиак, большинство неметаллов, как уже упоминалось, удаление электронов, окислитель, восстановитель

Ex. 7. Fill in the blanks with articles where necessary.

1. ... oxidation is ... removal of ... electrons from ... substance. 2. ... oxidation of ... chlorine to ... chloride ions takes place by ... gain of ... electrons. 3. ... oxygen is ... oxidizing agent. 4. ... meanings of ... terms ... oxidation and ... reduction are considered here. 5. ... change of ... ferrous oxide to ... ferric oxide is obviously ... oxidation.

Ex. 8. Give synonyms for the following:

addition, readily, therefore, full, apply, take an example, change, obviously, regard, include, occur, take, give

Ex. 9. Give antonyms for the following:

complex, removal, opposite, decompose, reduction, decrease, positive, metal, incomplete, exclude, loss, accept

Ex. 10. Translate the sentences into Russian.

1. To anticipate a little, there are several meanings of the terms "oxidation" and "reduction". 2. To be sure, any student can easily give an example of oxidation. 3. To begin with, one can say that the simplest meaning of the term "oxidation" is the addition of oxygen to a substance

and reduction is the opposite. 4. Needless to say, this meaning is incomplete. 5. To sum up, relatively little is known about the state of solid solutions or the conditions of equilibria which exist therein. 6. To mention only one, we shall consider in some detail the theory of electrolytic dissociation in its application to homogeneous equilibria. 7. Suffice it to say that similar results can be derived for other systems under investigation. 8. To put it in another way, the attraction between molecules varies inversely. 9. To tell the truth, these measurements vary so widely that it seems difficult to include them in this article. 10. Thorium, plutonium, mendelevium — not to mention uranium — belong to the actinoid series. 11. To summarize, no satisfactory equation for the process has been proposed. 12. The method is somewhat risky and not easily generalized, to say the least. 13. To put it more exactly, these values are now regarded as normal. 14. To say nothing of the details, an oxidizing agent is a substance which brings about oxidation. 15. Metals and hydrogen form positive ions, that is to say, they are electropositive. 16. To take an example, hydrogen and carbon are reducing agents. 17. To illustrate, a change of ferrous ion to ferric takes place by loss of an electron. 18. One of the aims of education is to extend student's views, his philosophy, so to say. 19. As emphasized above, this condition is satisfied automatically. 20. As already mentioned, we find cases where solution occurs with evolution of heat. 21. Roughly speaking, the conception of free ions affords very satisfactory explanation of all these phenomena. 22. Broadly considered, a heterogeneous system is one which consists of more than one physical state. 23. Put another way, one molecule gives rise to two smaller molecules or atoms. 24. Strictly speaking, it is for this reason that we shall to a large extent limit ourselves to a brief consideration of a gaseous state. 25. As pointed out previously, the term "oxidation" has a long history. 26. As stated above, the meaning of reduction is the opposite of oxidation. 27. Generally speaking, oxidation is removal of electrons.

Ex. 11. Translate the sentences into English without using a dictionary.

1. Первое, о чем обычно думают, говоря об окислении, — это то, что окисление представляет собой присоединение кислорода. 2. Соответственно, восстановление — это противоположный процесс. 3. Однако теперь эти термины применяются и к реакциям, в которых ни кислород, ни водород не участвуют. 4. Современные понятия окисления и восстановления связаны с переносом электронов. 5. Для химика окисление — это удаление электронов.

Ex. 12. Answer the following questions:

1. What is the meaning of the term "oxidation"? 2. In what sense is hydrogen the chemical opposite to oxygen? 3. Why is the change of any ferrous compound to a ferric compound regarded as an oxidation? 4. What is an oxidizing agent? 5. What is a reducing agent? 6. What are the most common oxidizing and reducing agents?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

sort, extensively, systematically, introduction, primitive, metallurgical, restoration, nomenclature, term, natural, original

Упр. 2. Проверьте, помните ли вы значения следующих слов; если нет, обратитесь к словарю:

prior to, combustion, phlogiston, conceive, charcoal, dual, rust

Text 31 B

Прочтите текст про себя (контрольное время чтения — 3 минуты).

Original Meanings of Oxidation and Reduction

Prior to the discovery of oxygen independently by Scheele of Sweden in 1771–1772 and by Joseph Priestley of England in 1774, combustion had been regarded to be a loss of phlogiston. Roughly speaking, phlogiston was conceived to be a sort of *materia* of fire. Lavoisier used the new knowledge to show more extensively and systematically that combustion is the combination of the combustible substance with Priestley's "dephlogisticated air". Knowing that several products of combustion, notably those formed from sulphur, phosphorus and carbon are acidic substances, Lavoisier named the element *oxygen*, from the Greek for *acid-former*.

Lavoisier called the product formed by addition of oxygen an oxide. Therefore, it was natural to refer to the process as oxidation.

To tell the truth, long before the introduction of the term "oxidation" the term "reduction" had been used in a technical sense. Primitive man had used charcoal to win iron from ores which we call oxides. During the development of this and other metallurgical processes reduction was used, perhaps in the dual sense of bringing down the bulk of an ore to that of the metal and of a restoration. In the latter sense it was used by Paracelsus in describing the restoration of iron from rust.

With de Morveau, Berthollet and de Fourcroy — to mention only a few — Lavoisier devised the nomenclature used today. Oxides were distinguished by the name of the element combined with oxygen and by the degree of oxidation.

Упр. 3. Передайте основное содержание текста своими словами в нескольких предложениях.

Упр. 4. Какое слово в тексте означает «добыть»?

Упр. 5. Найдите в тексте ответы на следующие вопросы:

1. What was regarded as combustion before the discovery of oxygen? 2. What was understood by the term "phlogiston"? 3. What was the origin

of the name "oxygen"? 4. In what sense was the term "reduction" used? 4. What process was called oxidation?

Упр. 6. Закончите следующие предложения:

1. Oxygen was discovered independently... 2. Lavoisier showed more extensively that... 3. Lavoisier regarded an oxide as a product... 4. In metallurgy the term "reduction" meant... 5. The nomenclature used today was devised...

Section III

Ex. 1. Make up short dialogues according to the example.

Example:

— Where are you from?
— I'm from Novgorod.
— Oh, I've never been to Novgorod, but I know it is a beautiful town.
— Oh, yes. There are a lot of interesting places there.

Ex. 2. Respond to the following statements:

1. You know, there are several meanings of the word "reduction". 2. However strange it may seem, the term "reduction" has several meanings, too. 3. Now reduction is regarded by chemists as the addition of electrons to a substance.

Ex. 3. Give detailed answers to the questions.

1. Why are the terms "oxide" and "oxidation" associated with the name "oxygen"? 2. In what way did the terms "oxidation" and "reduction" change throughout the history of chemistry? 3. What do you understand by these terms now?

Ex. 4. Discuss the following topics:

1. The Essence of the Processes of Oxidation and Reduction.
2. The Contribution of Various Chemists into the Development of Redox Chemistry.
3. The Aspects of Modern Redox Chemistry.

Part Seven

EMPHATIC CONSTRUCTIONS

Lesson 32

ГРАММАТИКА: Эмфатические конструкции. Усилительное *do*. Эмфатические конструкции типа *It is... that...*

Section I

Ex. 1. Practise your reading.

It was largely analytical chemistry that existed in the 18th and most of the 19th century.

Ex. 2. State what parts of speech the following words belong to:

analyse, analysis, analytic, analytical, analytically, analyser, analyst, analyte

Ex. 3. Define the meanings of the word *place* in the following sentences.

1. All the chemicals in the laboratory should be kept in their right places. 2. Please, place the burner on the asbestos support. 3. It would be out of place here to discuss these factors in detail. 4. If I were in your place, I would consult the laboratory assistant. 5. May I do it in place of you? 6. Lavoisier placed great emphasis on quantitative measurements in his experimental work. 7. Oxidation may take place in a process where no oxygen is involved.

Ex. 4. Analyse the following sentences.

1. The terms "oxide" and "oxidation" were derived from the name of the element "oxygen".

2. It was from the name of the element oxygen that the terms "oxide" and "oxidation" were derived.

Text 32 A

Analytical Chemistry — the Oldest Field of Chemistry

Analytical chemistry is probably the oldest field in the broad spectrum of the science of chemistry. Many years were required to dispel the lure of alchemy; more were needed to demonstrate the fallacy of the phlogiston theory. However, it was not until the brilliant French chemist Lavoisier (1743–1794) demonstrated, about 1785, by actual experimental methods that combustion was a combination of a substance with oxygen, that he laid the basic groundwork of modern chemistry, and, in a very particular sense, analytical chemistry. Indeed, he can with considerable justification be called the "father" of analytical chemistry because of the great emphasis he placed in all experimental work on quantitative measurement. It is in this very necessary characteristic of the true analytical chemist that he differed from Priestley (1733–1804), a discoverer of oxygen. Priestley, a clergyman forced to flee from Birmingham, England, to America because of his unorthodox political and religious views, was more of a philosopher than a scientist.

The first problem to engage the interest of most chemists was to determine as exactly as possible the composition of the earth. Greater emphasis was perhaps placed on chemistry than physics at this stage in the evolution of the natural sciences — yet, the contributions of such scientists as Avogadro, Boyle, and Charles all had a direct bearing and, therefore, great usefulness in analysis. Avogadro's law, for example, is extremely important in the chemistry of gases, because it does serve as a basis for relating weight to volume. Indeed, it is not an overstatement to say that during the 18th and most of the 19th century the chemistry that did exist was largely analytical chemistry. The pinnacle of ambition of most chemists at that time was to be a highly successful analyst. Any study of chemical literature of this period shows a preponderance of titles related to analytical chemistry.

It was in the latter half of the 19th century that the so-called "industrial revolution" took place. Many beginnings (modest at first) were made in the industrial manufacture of numerous items consumed in the household which were traditionally produced in the home or not at all. The raw materials in such manufacturing operations consisted chiefly of chemicals.

The pressing and dyeing of textiles, the production of glass, leather, soap — these are merely four examples (many others could be quoted) of operations that moved slowly out of the home and into the factory. Slowly, but surely, this trend built up a demand for modest changes for a limited number of chemicals. Except for the natural dyes and tanning extracts, most of the industrial chemicals produced in this area were inorganic in nature, principally alkalies, mineral acids, etc.

area, analytical, as... as (possible), broad, chief, chiefly, consume, demand, etc., exactly, be forced, former, highly, house, indeed, justification, latter, the former... the latter, literature, by/in nature, not at all, operation, perhaps, press, quote, raw, in a sense, in the sense of, stage, successful, successfully, title, traditional, traditionally, usefulness, view, yet

Ex. 5. Give the Russian equivalents for the following:

the phlogiston theory, demonstrate the fallacy of a theory, in a very particular sense, indeed, with justification, place emphasis on, because of one's views, be more of a scientist than, in the evolution of the natural sciences, the so-called "industrial revolution", raw materials, the production of glass, quote an example, slowly but surely, modest changes, be inorganic in nature

Ex. 6. Give the English equivalents for the following:

аналитическая химия, требовать, блестящий химик, современная химия, называть отцом химии, экспериментальная работа, истинный химик, отличаться от, быть вынужденным, как можно точнее, состав вещества, на этой стадии, вклад ученых, быть чрезвычайно важным, служить основой, не будет преувеличением сказать, в то время, во второй половине XIX века, быть скромным, промышленное производство, состоять из, за исключением природных красителей

Ex. 7. Fill in the blanks with articles where necessary.

1. Analytical chemistry is regarded as ... oldest field of ... chemistry. 2. Many years were needed to demonstrate ... fallacy of ... phlogiston theory. 3. Avogadro's law is extremely important in ... chemistry of ... gases. 4. ... pressing and dyeing of textiles are ... examples of operations that moved into ... factory. 5. Most of ... natural dyes were inorganic in ... nature.

Ex. 8. Give synonyms for the following:

branch, wide, require, show, remarkable, accurately, step, however, highly, mainly, occur, production

Ex. 9. Give antonyms for the following:

young, necessary, from, more, impossible, usefulness, slowly, successful a considerable number

Ex. 10. Translate the sentences into Russian.

1. It is the analytical chemistry that is regarded as the oldest field of chemistry. 2. It is M. V. Lomonosov who is the founder of Russian physics and chemistry. 3. It was my supervisor who advised me to use this apparatus. 4. It was Mendeleyev's periodic law which served as a key to discovering

new elements. 5. It was not my teacher whom I addressed my question to. 6. It was in 1869 that Mendeleyev's periodic system was published. 7. It is horizontal rows of the periodic table which are called periods. 8. Ozone does remove harmful ultraviolet radiation from sunlight. 9. It is not this examination that is the most difficult this term. 10. It was not till late in the 19th century that numerous household items began to be produced at factories. 11. These results do support the kinetic treatment of the behaviour of particles in colloidal solutions. 12. It is only at ordinary temperature that the agreement between the two methods is satisfactory. 13. It was not until the results concerning solid solutions had been obtained that a general conclusion was reached. 14. The reaction does proceed slowly in most cases. 15. It was evident that the resulting mixture did obey the mixture law. 16. The use of deductive methods shows that all these cases come from one and the same root. 17. It is not until a substance undergoes distribution that it has the same molecular weight in the two phases. 18. It is not until two pieces of zinc and copper are brought into contact that they become electrified. 19. In the actual case the density of the vapour does alter with the height. 20. It was not until oxygen was discovered that many processes could be understood.

Ex. 11. Translate the sentences into English without using a dictionary.

1. Считается, что аналитическая химия — старейшая отрасль химии. 2. Потребовалось много лет, чтобы показать, что теория флогистона неверна. 3. Развитие экспериментальных методов внесло большой вклад в исследование состава веществ. 4. Развитие промышленности сыграло большую роль в разработке новых методов аналитической химии. 5. Многие операции, производившиеся ранее дома, стали производиться в промышленных масштабах.

Ex. 12. Answer the following questions:

1. Whose investigations helped to prove the fallacy of the phlogiston theory? 2. Why is Lavoisier called the "father" of analytical chemistry? 3. Why is analytical chemistry regarded as the oldest branch of chemistry? 4. What problems engaged the interest of most chemists at that time? 5. Why did the development of industry stimulate the development of analytical chemistry?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

process, routine, test, prestige, technician, person, professional, era, indicate, apparatus, finish, front, organization

Упр. 2. Проверьте, помните ли вы значения следующих слов; если нет, обратитесь к словарю:

plant, employ, quality, quantitative, constituent, perform, be concerned with, exclusively, relationship

Text 32 B

Прочтите текст про себя (контрольное время чтения — 2 минуты).

Two Branches of Analytical Chemistry

The relatively small chemical manufacturing plants producing such chemicals as alkalis, sulphuric acid, etc., indeed, some of the factories making consumer goods and employing chemicals in the processing, soon found it desirable to employ what was most frequently referred to as a "works chemist". His duties consisted largely of performing routine tests to determine the quality of the raw materials coming in, so to speak, the back door, and the finished goods going out of the front. In nearly every instance the "works chemist" reported to the factory manager. The analyst's prestige within the organization was largely that of a technician, rather than a person considered to be professional.

The "works chemist" or analyst of this era was concerned almost exclusively with two branches of analytical chemistry, namely, qualitative analysis and quantitative analysis. In qualitative analysis, interest is directed to determine the constituent parts of a given product, without any effort to determine the quantitative relationships of these parts. Quantitative analysis, on the other hand, as a term does very definitely indicate, is directly concerned not only with determining the constituent parts, but how much of each is present.

It is these two branches of chemistry that are still regarded to be main constituent parts of modern analytical chemistry, though the methods and apparatus used by the analytical chemists nowadays have greatly changed.

Упр. 3. Передайте основное содержание текста в нескольких предложениях.

Упр. 4. Какие слова в тексте означают «потребительские товары»?

Упр. 5. Найдите в тексте ответы на следующие вопросы:

1. What fields of industrial manufacture required chemists' services? 2. What did chemists have to do at plants and factories? 3. What branches of chemistry did the "works chemist" deal with? 4. What is the difference between qualitative analysis and quantitative analysis? 5. Do these two branches of analytical chemistry exist now?

Упр. 6. Закончите следующие предложения:

1. Some of the factories found it desirable... 2. The main duty of an industrial chemist was... 3. The analyst of that era... 4. The aim of qualitative analysis is... 5. Quantitative analysis is directly concerned... 6. At present, analytical chemistry...

Section III

Ex. 1. Make up short dialogues according to the example.

Example:

— Excuse me!
— Yes?
— Is there a canteen at the department?
— Yes, there is.
— Where is it?
— Not very far, just downstairs and round the corner.
— Thank you very much.
— That's all right.

Ex. 2. Respond to the following statements:

1. It's interesting to note that the very first factories and plants paid great attention to the quality of the raw materials and finished goods. 2. I don't know whether the prestige of the analyst is high in industry now, but in the 19th century it wasn't. 3. Often, it is not sufficient to determine what constituent parts are present in a given product.

Ex. 3. Give detailed answers to the questions.

1. What is the origin of analytical chemistry? 2. How did analytical chemistry change with time? 3. What are the main constituent parts of analytical chemistry?

Ex. 4. Discuss the following topics:

1. The Contribution of Outstanding Scientists to the Development of Analytical Chemistry.
2. Qualitative and Quantitative Analyses.
3. Modern Analytical Chemistry.

Lesson 33

ГРАММАТИКА: Эмфатические уступительные предложения.

Section I

Ex. 1. Practise your reading.

Gradually, chemists began synthesizing some things found in nature and later those not found in the natural state.

Ex. 2. State what parts of speech the following words belong to:

nature, natural, unnatural, naturally, naturalist, naturalistic, naturalism, naturalize, naturalization

Ex. 3. Define the meanings of the word *follow* in the following sentences:

1. You must exactly *follow* the instruction. 2. Some of the results obtained at 25°C are as *follows*. 3. Since the ratio is constant, it *follows* that the molecular weight of iodine is the same in liquid as in solid benzene. 4. It is necessary to have a definition of science, I suggest the *following*. 5. This principle will be *followed* throughout the book. 6. Caesium and rubidium are of importance because caesium, *followed* by rubidium, is the most easily ionized element. 7. It *follows* from the above that no substance can be absolutely pure. 8. I'll go first and you *follow* me. 9. Can you *follow* my explanation? 10. The lecture will be *followed* by a film. 11. *Following* the seminar we'll be allowed to make our experiments.

Ex. 4. Analyse the following sentences:

1. Though it may seem strange now, analytical chemistry began to experience a renaissance between WWI and WWII.

2. Strange as it may seem now, analytical chemistry began to experience a renaissance between WWI and WWII.

3. However strange it may seem, analytical chemistry began to experience a renaissance between WWI and WWII.

Text 33 A

Classical Methods of Analysis

Strange as it may seem now, the analyst and the "works chemist" of the 18th and 19th centuries depended almost entirely on what are frequently defined today as the classical methods of analysis, namely, gravimetric analysis and volumetric analysis. Gravimetric analysis is based on methods of determining the weights of the respective constituents of a product, whereas volumetric analysis is based on volumes rather than weights, the volumes being determined by a process known as titration — that is, determination of the strength of acid and basic solutions.

Difficult as the situation of the so-called "works chemist" during the industrial revolution was, it was not the sole reason for the decline of the glamour and prestige of the analyst in the early days of the science of chemistry.

Following the logical sequence of events, it is not at all strange that chemist, having taken natural substances apart in order to determine their constituent elements, would then begin gradually to think about synthesizing in a test-tube, at least some of the useful things found in nature. The next logical step, of course, was to begin to think about producing things not found in the natural state. Thus, we had an evolution of research, principally in organic chemistry, directed towards synthesizing old or new compounds, chiefly the latter.

About halfway between World War I and World War II, the analytical chemist gradually began to experience a renaissance in his status with

other members of the profession and with management. Quality became a very important factor in ever-increasing competitive markets. With this welcome change there came a demand for more rapid and more accurate methods of analysis. This demand led to a tremendous amount of research related to the broad field of analysis. New scientific concepts were introduced, many of them based on what might be called physical chemistry.

Words and Word-Combinations to Be Memorized

canteen, department, event, excuse, frequently, gradually, lecture, a lot of, lots of, manage, market, profession, quality, respective, scientific, seminar, sequence, synthesize, test-tube, thank, tremendous, tube

Ex. 5. Give the Russian equivalents for the following:

depend on the classical methods, be defined as, gravimetric analysis, volumetric analysis, respective constituents, determine the volumes, the strength of acid and basic solutions, a difficult situation, the sole reason, in the early days of chemistry, following the sequence of events, experience a renaissance, competitive markets, introduce a concept

Ex. 6. Give the English equivalents for the following:

казаться странным, почти полностью, определить все, тогда как, а не, затруднительное положение, совсем не странно, природные вещества, чтобы определить, постепенно, синтезировать в пробирке, по крайней мере, следующий шаг, таким образом, главным образом, химик-аналитик, потребность в новых методах анализа, огромное количество исследований, основываться на, быть направленным на, часто

Ex. 7. Fill in the blanks with articles where necessary.

1. In ... volumetric analysis ... volumes were determined by ... process known as ... titration. 2. ... situation of ... so-called "works chemist" was rather difficult. 3. ... evolution of ... research led to synthesizing old or new compounds, chiefly ... latter. 4. ... quality became ... very important factor. 5. There came ... demand for more rapid and more accurate methods of ... analysis.

Ex. 8. Give synonyms for the following:

at present, wholly, single, start, mainly, fast, wide, idea, produce, often

Ex. 9. Give antonyms for the following:

frequently, easy, late, together, at once, useless, revolution, old, the latter, decrease

Ex. 10. Translate the sentences into Russian.

1. Whenever an element is oxidized, some elements must be reduced. 2. Wherever sulphide ores of the metals such as lead, copper, zinc may

be found, there, too, we are likely to find sulphur compounds of arsenic. 3. Strange as it may seem, considering its vital importance and the fact that it is around us everywhere, conscious acquaintance with oxygen dates back to only a little over two centures ago. 4. The energy involved in any reaction is usually called the heat of reaction, even though it may be electrical in nature. 5. The critical temperature is the highest temperature at which a vapour can be condensed to liquid by any pressure, however great it may be. 6. Whenever a person working in the laboratory mixes two or more substances and obtains a new product, he wants to know what has happened and what substances have been produced. 7. However that may be, the agreement between the two methods is satisfactory. 8. Important though it is, we shall not consider this case now. 9. Crude though it is, this value is most frequently employed. 10. Relatively little is known about the conditions of equilibrium which exist in the solid solution, whoever may say the opposite. 11. Whatever these observations may appear, such solutions obey Ohm's law, just as metallic conductors do. 12. Simple though it actually is, this method has the advantage of being simple and flexible and of involving usually only moderately complicated considerations. 13. This technique remains unreliable, although it has recently been improved. 14. Whatever you may say, this circumstance no doubt prevented earlier observers from accepting the concept. 15. Convenient as this method is, it has a drawback which involves a certain risk. 16. However that may be, we may raise the temperature and find a continuous series of equilibrium states. 17. Whenever a beam of white light is passed through a prism, it spreads it out into a spectrum containing all the colours from red to violet. 18. Improbable though this case may appear at first glance, let us consider it in detail.

Ex. 11. Translate the sentences into English without using a dictionary.

1. Как это ни странно, многие методы анализа используются и сейчас. 2. Такими классическими методами анализа являются гравиметрический анализ и объемный анализ. 3. Химики сначала разделяли природные вещества, чтобы определить составляющие их элементы. 4. Постепенно они начали думать о том, чтобы синтезировать некоторые полезные вещества в пробирке. 5. Затем они подошли к следующей ступени — синтезировать совершенно новые вещества. 6. Рост требований к качеству привел к дальнейшему совершенствованию методов анализа.

Ex. 12. Answer the following questions:

1. What methods of analytical chemistry are called the classical methods of analysis? 2. What is gravimetric analysis based on? 3. What is volumetric analysis? 4. How did chemists come to the idea of synthesizing a substance? 5. What stimulated the evolution of methods of analysis?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

modern, instrumental, calorimetry, spectrometry, effect, spectrography, diffraction, radiometric, polarography, modification, instrument, microanalysis, macroanalysis, perspective, scale, fortune

Упр. 2. Проверьте, помните ли вы значения следующих слов; если нет, обратитесь к словарю:

by no means, supersede, supplement, supplant, wet, fluorimetry, continuous, size, sample, trace, team, wheel

Text 33 B

Modern Methods of Analysis

Прочтите следующий текст про себя (контрольное время чтения — 3 минуты).

The so-called classical gravimetric and volumetric methods have by no means been superseded by physical chemistry and physical methods. Unlikely as such a statement may seem, instrumental analysis, as it is known today, supplements rather than supplants the so-called classical wet methods. Such terms as calorimetry, spectrophotometry, Raman effect, fluorimetry, spectrography, X-ray diffraction, radiometric methods, polarography, etc., are in common usage and every part of the analytical work now performed is through the use of instrumentation. Indeed, modifications of many of these instruments are now being moved out into actual manufacturing operations in order to provide continuous analysis.

One of the more modern developments in the field of analysis is that of microanalysis, employed where the size of the samples is considerably smaller than used in the type of analysis sometimes defined as macroanalysis. Today quite a number of analysts are directly concerned with what is frequently defined as trace analysis. The determination of very low concentrations is often of great importance in maintaining high quality of a product. A wide variety of new techniques have been developed to meet this need. Another field currently receiving greater attention is the matter of scientific sampling. Certainly, no method of analysis, accurate as it may be, will give a proper perspective if the sample employed is not reasonably representative of the whole.

Today the research analyst in the chemical process industries is an honoured member of the "team". The use of this term has become widespread to describe the modern "team approach" to the discovery, development, and full-scale production of new products. Thus, the wheel of fortune for the analyst has made a complete circle.

Упр. 3. Передайте основное содержание текста в нескольких предложениях.

Упр. 4. Какие слова в тексте означают «быть непосредственно связанным с...»?

Упр. 5. Найдите в тексте ответы на следующие вопросы:

1. What is the position of instrumental analysis in analytical chemistry? 2. What is the purpose of modifying instruments? 3. What is the difference between macroanalysis, microanalysis and trace analysis? 4. What requirements should the sample meet to allow the analyst to obtain proper results? 5. What is the position of the research analyst in industry or organization at present?

Упр. 6. Закончите следующие предложения:

1. Gravimetric and volumetric methods... 2. The use of instrumentation... 3. A wide variety of new techniques have been developed... 4. A sample employed must be... 5. Now the research analyst in the chemical process industries...

Section III

Ex. 1. Make up short dialogues according to the example.

Example:

— Is there any acid in the bottle?
— Yes, there is.
— How much acid is there?
— There's a lot. Shall I give it to you?
— Yes, please, bring it here.
— Here you are.

Ex. 2. Respond to the following statements:

1. It doesn't seem strange to me that the so-called classical wet methods are still in use. 2. The use of instrumentation is essential for modern methods of analysis. 3. The role of the analyst in the chemical industries is very important now, isn't it?

Ex. 3. Give detailed answers to the questions.

1. What instrumental methods of analysis do you know? 2. In what directions are analytical methods developed? 3. Under what conditions can the analyst obtain good results?

Ex. 4. Discuss the following topics:

1. The Role of Analytical Chemists in Various Periods of the History of Chemistry.
2. The Development of Various Analytical Methods.
3. Working in a Team — Advantages and Disadvantages.

Lesson 34

ГРАММАТИКА: Различные случаи инверсии.

Section I

Ex. 1. Practise your reading.

Used in the design and interpretation of chemical experimentation are various statistical methods.

Ex. 2. State what parts of speech the following words belong to:

act, actual, actually, action, interaction, acting, active, activity, activist, reactivity, reaction, counteraction, actor, activate, activation

Ex. 3. Define the meanings of the word *extent* in the following sentences:

1. The *extent* of the accuracy of the instrument is rather limited. 2. Mercury undoubtedly dissolves to a certain *extent* in the water. 3. If water is added to ether, solution will not occur to an indefinite *extent*. 4. The concentration of iodine molecules must decrease to a greater *extent* than that of iodine atoms. 5. In liquids, the *extent* to which molecules can move is more restricted than in gases. 6. The discovery of the electron stimulated to some *extent* the development of an electronic theory.

Ex. 4. Analyse the following sentences:

1. Statistical methods can never be a substitute for scientific judgement.
2. Never can statistical methods be a substitute for scientific judgement.

Text 34 A

Statistical Methods in Analytical Chemistry

Statistical methods, as used in the design and interpretation of chemical experimentation, are not a substitute for common sense or for what scientists refer to as scientific judgement; they rather constitute an objective aid to judgement. In view of the meticulousness exhibited by scientific workers in the purely technical aspects of their experiments it seems appropriate to devote some thought to two further and no less important aspects of experimentation: its design and the final interpretation of its outcome. Very often the experimenter designs the experiment as it proceeds, acting on a moment's intuition. Similarly, the interpretation or a rudimentary study of data, the latter consisting in many cases in ranking studied effects in accordance with their observed disturbances caused by experimental and systemetic errors. Naturally, even the most experienced worker is subject to an occasional intuition. Therefore natural, and actually borne

out by the facts, is the assumption that many experiments could have resulted in more conspicuous and sharper constructed plan.

In taking cognizance of the unavoidable experimental errors, rather than in ignoring them or dismissing them as negligible, and in attempting a mathematical study of the avoidance or the correction of systematical errors, statisticians have succeeded, to a certain extent, in offering some objective criteria which are invaluable in these situations. One of the important by-products of these methods is an estimate of the quantity of experimental work that is necessary for obtaining sufficient factual proof for a scientific hypothesis, such an estimate being more objective than the guessing technique often used. But among the most important contributions of statistical methodology to scientific experimentation is the possibility of clearly separating the effects of various variables under study as well as the interactions of these variables with regard to the measured quantities, from the data resulting from a complex experiment. Hardly can it be denied that this requires careful planning. Even before the experiment is started, the various possible types of results must be hypothetically considered from the point of view of the questions under study.

Words and Word-Combinations to Be Memorized

aid, by-product, common sense, construct, construction, contribution, correction, criterion, data, design, error, experienced, the extent to which, mathematics, negligible, objective, occasion, offer, point of view, possibility, proof, refer to as, statistical, statistics, substitute, succeed (in), sufficient, sufficiently, in view of

Ex. 5. Give the Russian equivalents for the following:

be a substitute for, an aid to judgement, in the purely technical aspects, it seems appropriate, the design of the experiment, act on a moment's intuition, be subject to, ignore experimental errors, the correlation of errors, an objective criterion, obtain sufficient factual proof, guessing technique, result from a complex experiment, require careful planning, consider from the point of view of

Ex. 6. Give the English equivalents for the following:

здравый смысл, ввиду многих ошибок, объяснение результатов эксперимента, планировать эксперимент по мере его протекания, изучение данных, в соответствии с наблюдаемыми фактами, опытный исследователь, естественное предположение, приводить к экспериментальной ошибке, избегать систематических ошибок, статистикам удалось сделать, быть бесценным, предложить объективные критерии, один из побочных продуктов, изучаемые переменные, взаимодействие переменных, до начала эксперимента, рассматривать с точки зрения

Ex. 7. Fill in the blanks with articles where necessary.

1. Statistical methods are not ... substitute for ... common sense. 2. Two important aspects of ... experimentation are its ... design and ... final interpretation of ... results. 3. Very often ... experimenter acts on ... moment's intuition. 4. Experimental work is necessary for obtaining ... sufficient factual proof for ... scientific hypothesis. 5. Before ... experiment is started it is necessary to consider ... various possible results hypothetically.

Ex. 8. Give the synonyms for the following:

help, show, more, facts, supposition, take notice of, amount, demand, begin, kind

Ex. 9. Give the antonyms for the following:

first, the former, contrary to, inexperienced, regular, take into account, insufficient, the same, simple, after, finish

Ex. 10. Translate the sentences into Russian.

1. Students of chemistry have to perform a number of experiments studying the properties of any substance and so do students of geology. 2. Considered as isotopes are atomic species having the same number of neutrons but different mass numbers. 3. Not only does chlorine unite with free hydrogen, but it has the ability to take hydrogen from hydrocarbon compounds. 4. Only upon heating above 500°C does zinc burn with a greenish flame, yielding zinc oxide. 5. No sooner is a solid brought into contact with liquid in which it can dissolve than a certain amount of it passes into solution. 6. The first phase consists of excess of phenol and a small quantity of water, so does the second one. 7. One liquid layer does not contain water, nor does the other. 8. Included in this table are densities of liquid and vapour. 9. Not until 1869 was this theory put forward. 10. Neither should we forget to check the purity of the substances to be handled. 11. Nowhere is it so important to have skilful hands as in a chemistry laboratory. 12. Never is it so important to think about style as in writing a textbook. 13. Never has more accurate result been obtained. 14. He was always ready to answer any question and so was his friend. 15. Hardly had we heated the test-tube several minutes when an explosion suddenly happened. 16. Important for this conclusion is the arrangement of atoms in the molecules. 17. Correlative with the hypothesis are the results of the latest series of experiments. 18. Great are differences in selectivity between intermediates. 19. Plotted in Figure 5 is the variation of selectivity.

Ex. 11. Translate the sentences into English without using a dictionary.

1. Очень важными в аналитической химии являются статистические методы. 2. Едва ли можно сказать, что планирование экспери-

мента — простое дело. 3. Объяснить конечный результат реакции бывает непросто и опытному химику. 4. Ученым удалось выработать некоторые методы, чтобы избежать ошибки при проведении экспериментов. 5. Объективными критериями правильности научной гипотезы можно считать только факты.

Ex. 12. Answer the following questions:

1. In what fields of analytical chemistry can statistical methods be used? 2. What important aspects of experimentation should be taken into account? 3. What is the role of intuition in experimentation? 4. What must be the attitude to errors? 5. What is regarded as the most important contribution of statistical methodology to scientific experimentation?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

fundamental, balance, operation, utilize, limitation, intuitive, extreme, delicate, calibration, specialize, actually, visualize, ordinary

Упр. 2. Проверьте, помните ли вы значения следующих слов; если нет, обратитесь к словарю:

tool, capability, realize, take for granted, precise, ratio, yield, tend, teeter-totter, pendulum, upright, axle

Text 34 B

Прочтите текст про себя (контрольное время чтения — 2 минуты).

Fundamentals of the Analytical Balance

Of great importance in the laboratory is the analytical balance, one of the most common laboratory tools. Its usefulness increases when the chemist understands its operation well enough to utilize the full capabilities and to realize the limitations of the balance.

Some chemistry students do not become proficient in the use of the balance, understandably, they are concerned with so many other and complex instruments and problems. The balance is taken for granted. It may be that, because balances have been used for so many centuries, intuitive knowledge about them is assumed. At the other extreme are those who know there is something precise and presumably delicate about a balance, and so they avoid using one if possible. This is unfortunate because mass, along with length and time, is a fundamental measurement. An example is the use of the balance to prepare standards for the calibration of more specialized instruments. Another important thing about a balance is its high ratio of capacity to sensitivity. Few measurements will yield as many significant figures as weighing on an

analytical balance. Results to six significant and exact figures are ordinary.

Those who have learned about balances by an intuitive process tend to think of them as teeter-totters. Actually a balance is a compound pendulum with complications. The essentials of the operation can be understood easily, however, by visualizing an upright wheel free to turn on a fixed axle...

Упр. 3. Передайте основное содержание текста в нескольких предложениях.

Упр. 4. Какое слово в тексте означает «искусный, умелый»?

Упр. 5. Найдите в тексте ответы на следующие вопросы:

1. When does analytical balance become a useful tool in the laboratory? 2. What is the attitude of students to the use of analytical balance? 3. What measurements are regarded as fundamental? 4. What is the characteristic feature of analytical balance? 5. What is the design of the analytical balance?

Упр. 6. Закончите следующие предложения:

1. Analytical balance is... 2. Chemistry students are concerned with... 3. Some students avoid using a balance because... 4. The balance can be used to prepare standards for... 5. Usually, a balance is thought to be...

Section III

Ex. 1. Make up short dialogues according to the example.

Example:

— Can I help you?
— Yes. I'd like some information about foreign journals on chemistry in this library.
— What field of chemistry are you interested in?
— Nature compounds.
— Let's use the computer, we'll find all the information you need.

Ex. 2. Respond to the following statemets:

1. Statistical methods are used not only for the design of experimentation. 2. To my mind, intuition is not important for chemists. 3. I don't think the balance is the most essential tool in a chemical laboratory, there are many others.

Ex. 3. Give detailed answers to the questions.

1. What methods are used in analytical chemistry? 2. What must students be able to do in a laboratory? 3. What aspects must be taken into account in planning experiments?

Ex. 4. Discuss the following topics:

1. Interpretation of Experimental Results.
2. Designs of Modern Analytical Balances.
3. How to Avoid Errors in Experimentation.
4. How to Estimate Experimental Errors.

Lesson 35

ГРАММАТИКА: Предложения с парным союзом *the... the...* . Двойное отрицание.

Section I

Ex. 1. Practise your reading.

When a solid is heated to incandescence, it emits more or less continuous spectrum.

Ex. 2. State what parts of speech the following words belong to:

continue, continual, continually, continuation, continuity, continuous, continuously, continuousness, continuum

Ex. 3. Define the meanings of the word *like* and its derivatives in the following sentences:

1. Do you *like* classical music? 2. Would you *like* to go to the theatre today? 3. I should *like* to discuss this problem now but we are short of time. 4. It's *likely* that the reaction will start after some heating. 5. The chemical formulas of these salts are *alike*: LiCl, NaCl, etc. 6. Oxygen can be made commercially, just *like* hydrogen, by the electrolysis of water. 7. *Unlike* oxygen, ozone has 3 atoms in a molecule. 8. The reaction will most *likely* take place with great evolution of heat and light. 9. Every laboratory must have glasses, tubes, beakers, bottles and the *like*. 10. Elements of the same group have *like* properties. 11. It is not at all *likely* that this assumption will come true. 12. The relationship discovered is *unlikely* to hold at low pressures.

Ex. 4. Analyse the following sentences:

1. It is unlikely that the error will be great. 2. It is not unlikely that the error will be great. 3. The sooner you get acquainted with the equipment, the better.

Text 35 A

Investigations of Spectra

The more profound is the investigation of the structure of atoms and molecules, the more problems arise. It was not long ago that consideration

of the extra-nuclear electrons was restricted to an indication that their number must equal the atomic number of the element, and to a mention of the fact that they form a relatively open structure about the central nucleus. The question of their arrangement must now be discussed in detail, and in this connection valuable information has been obtained from an examination of both optical and X-ray spectra, the former term being used to describe spectra in the ultraviolet, visible and infra-red regions.

When a solid is heated to incandescence, it emits a more or less continuous spectrum, but gases and vapours under the same conditions, when examined spectroscopically, show a series often very complicated, of distinct lines or bands occupying definite positions, that is, with definite wave lengths. The more information concerning the composition of various spectra was obtained, the clearer it became that the line spectra are produced by atoms and so are not unfrequently referred to as atomic spectra, whereas the so-called band spectra, which can, in fact, often be resolved into large number of closely spaced lines, are obtained from molecules.

A line spectrum is the one formed when radiation from an incandescent gas is passed through a slit and then dispersed. The lines are produced by energy changes when electrons pass from high energy quantum levels to low energy quantum levels. The electrons are excited from low to high levels by the input of energy into the gas — usually in a discharge tube under a high voltage.

In a molecular spectrum, a series of fairly broad bands is formed. These bands are sharp at one edge but dying away on the other. They arise from the complex energy changes possible in a molecule. Under high resolution, the band is shown to be made up of many lines sharper and clearer together at the head of the band but more diffuse away from the head of the band. It seems not at all unlikely that the more complex the molecule, the more complicated the spectrum is.

It is from atomic spectra in particular that information concerning the extra-nuclear electrons has been obtained.

Words and Word-Combinations to Be Memorized

band, complicated, concerning, on/under condition, connection, in connection with, diffusion, disperse, edge, emit, examination, excite, extra, in fact, the fact that, head, incandescent, infrared, investigate, length, most likely, not likely, nuclear, optical, in particular, pass, radiation, radiate, slit, spectroscopy, the... the..., unlikely, voltage

Ex. 5. Give the Russian equivalents for the following:

a profound investigation, restrict consideration to, mention the fact, in this connection, examine a spectrum, heat to incandescence, examine spectroscopically, a distinct line, resolve into a number of lines, pass from one level to another, excite electrons, by the input of energy, in a discharge

tube, a series of bands, arise from energy changes, under high resolution, information concerning extra-nuclear electrons

Ex. 6. Give the English equivalents for the following:

равняться атомному номеру элемента, относительно открытая структура, расположение электронов, оптический спектр, в инфракрасной области, испускать непрерывный спектр, при тех же условиях, занимать определенные положения, длина волны, получать информацию, линейный спектр, близко расположенные друг к другу линии, раскаленный газ, пропускать через щель, высокое напряжение, на одном конце, в частности

Ex. 7. Fill in the blanks with articles where necessary.

1. ... more is known about ... spectra, ... more questions arise. 2. When ... solid is heated to ... incandescence, it emits ... spectrum. 3. ... line spectra are produced by ... atoms. 4. ... electrons are excited in ... discharge tube under ... high voltage. 5. ... information concerning ... extra-nuclear electrons has been obtained particularly from ... atomic spectra.

Ex. 8. Give synonyms for the following:

examination, be limited to, question, important, evolve, a number of, clear, actually, get, give, likely, complex

Ex. 9. Give antonyms for the following:

disappear, recently, closed, different, indefinite, small, low, simple

Ex. 10. Translate the sentences into Russian.

1. It is not unusual to consider elements from the point of view of their properties. 2. Not unfrequently water itself acts as a catalyst in many reactions. 3. The higher the temperature, the greater is the viscosity of gases. 4. The greater the number of carbon atoms in a given structure, the more ways there are for arranging them. 5. The smaller the charges carried by the ions of a crystal and the larger the ionic radii, the weaker the forces that bind the ions to one another within the crystal, and the more readily the crystal structure is broken down. 6. It is not improbable that the results of their work will be similar to ours. 7. Vaporization proceeds faster, the higher is the temperature, pressure being constant. 8. The results will be in closer agreement, the more strictly the instruction is followed. 9. The accuracy of weighing is not inconsiderably influenced by the sensitivity of the balance used. 10. Under these conditions concentration is higher, the higher the temperature. 11. The harder you study, the better you master the subject. 12. The reaction is more efficient, the purer the chemicals. 13. The smaller the number of the element, the lighter it is. 14. The greater the quantity of heat possessed by the body, the greater is its hotness. 15. The earlier the history of chemistry, the more striking it is. 16. Not unfrequently the word has several meanings, e. g., the word "theory". 17. It seemed not

improbable that some elements occur as a mixture of isotopes in nature. 18. It is not at all unlikely that new elements will be discovered. 19. The properties of the element are not inconsiderably influenced by their atomic number. 20. The atomic weights of elements are not uncommonly revised after thorough studies in laboratories.

Ex. 11. Translate the sentences into English without using a dictionary.

1. Существует множество методов изучения структуры атомов и молекул. 2. Ценную информацию в этой связи можно получить из исследования спектров. 3. Ученые различают спектры атомов и молекул. 4. Атомы дают линейные спектры. 5. Молекулярные спектры называют полосатыми.

Ex. 12. Answer the following questions:

1. What information can one obtain from an examination of spectra? 2. What kinds of spectra are known? 3. When does a solid emit a spectrum? 4. Under what condition does a gas emit a spectrum? 5. What spectrum is called linear? 6. What is the difference between linear and band spectra?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

associate, surprise, doctor, demonstrate, composition, spectroscope, astronomy, detect, spectrographer, priority, journal, practically, publicity, publish, prestigious, reputation, orange, prevalent, characteristic, construct

Упр. 2. Проверьте, помните ли вы значения следующих слов; если нет, обратитесь к словарю:

scrutiny, be accustomed to, point out, celestial, application, in behalf of, flame, inaccessible, seek to, confuse, obstruct, stumble, discourage

Text 35 B

Прочтите текст про себя (контрольное время чтения — 3 минуты).

Who Is the Discoverer of Spectrum Analysis?

The more detailed is the scrutiny of the history of chemistry, the greater is the number of interesting facts that come to light.

Those accustomed to associate the name of Kirchhoff with the discovery of spectrum analysis will undoubtedly be surprised to learn that in the year 1854, five years prior to the work of Kirchhoff, an unassuming country doctor in a Pennsylvania village definitely demonstrated the possibility of determining various elements by means of their lines in the spectrum. In fact, this country doctor, David Alter, went further than this.

He pointed out that the method could be used to determine the composition of celestial bodies, thus laying the foundation for the application of the spectroscope in astronomy, among the modern sciences. He even called attention to the possibility of detecting impurities in a metal by this method, thus speaking the language of the most up-to-date spectrographer.

The only possible claim to priority over Alter's discovery can be made in behalf of Sir John Herschel, who in 1824 demonstrated the possibility of detecting small quantities of an alkali by its flame spectrum. However, this work was described in an inaccessible journal, thus receiving practically no publicity. Unfortunately, it is not unfrequently that this happens. That is why scientists usually seek to publish their papers in prestigious journals: the better the reputation of the journal, the sooner the information it contains comes to the reader. Furthermore, confused by the continual presence of the strong orange lines, later found to be sodium lines. Herschel soon regarded his own discovery as incorrect. The same prevalent sodium lines kept other physicists of that time from realizing that each element has its characteristic line in the spectrum.

Alter, however, was not obstructed by this stumbling block. Neither did the lack of scientific instruments discourage him. He ground his own prism and constructed his own apparatus.

Упр. 3. Передайте основное содержание текста в нескольких предложениях.

Упр. 4. Какое слово в тексте означает «удерживать, мешать»?

Упр. 5. Найдите в тексте ответы на следующие вопросы:

1. What will surprise those who study the history of spectrum analysis? 2. What conclusion did David Alter come to? 3. How did it happen that John Herschel's work remained unknown? 4. Why do scientists try to publish their papers in well-known journals? 5. What prevented Herschel from drawing the right conclusion?

Упр. 6. Закончите следующие предложения:

1. Five years prior to the work of Kirchhoff... 2. Alter pointed out that... 3. He called attention of other scientists to... 4. The priority of Herschel's work is shown by... 5. Herschel was confused...

Section III

Ex. 1. Make up short dialogues according to the example.

Example:

— Hello, Lena. Is Nick there?
— Yes, he is.
— What's he doing?
— He's busy with his paper. He's typing it.
— Can I speak to him?
— Just a moment, I'll call him to the phone.

Ex. 2. Respond to the following statements:

1. I'm not interested in the history of this or that phenomenon, the essence of it is the thing that matters. 2. It's not so easy to distinguish between various spectra. 3. I think spectroscopy is a very interesting field.

Ex. 3. Give detailed answers to the questions.

1. What do you know about the contribution of scientists to the development of spectrum analysis? 2. What kinds of spectra are known today? 3. How can they be obtained?

Ex. 4. Discuss the following topics:

1. Modern Methods of Analysis dealing with Spectra.
2. The Importance of Spectral Analysis for Analytical Chemistry.
3. The Application of Spectral Analysis in Sciences Other than Chemistry.

Lesson 36

ГРАММАТИКА: Общее повторение.

Section I

Ex. 1. Practise your reading.

The guiding light of theory must be confirmed by the bench of physical manipulation.

Ex. 2. State what parts of speech the following words belong to:

general, generally, generalize, generalized, generalization, generality

Ex. 3. Define the meanings of the word *question* in the following sentences:

1. Not every *question* can be answered at once. 2. The phenomenon in *question* is exactly analogous to those already described. 3. That water consists of oxygen and hydrogen is beyond *question*. 4. There is no *question* but that sulphuric acid is much stronger than sulphurous acid. 5. Naturally, *the question* arises as to the role of the solvent. 6. This is a *questionable* point of view. 7. That both these results are devoid of error is out of the *question*.

Ex. 4. Analyse the following sentences:

1. A burner is on my table. 2. There is a burner on my table. 3. The burner is on my table.

Text 36 A

Choosing Chemistry a Profession

The students enrolled for a course in general chemistry can and do ask themselves the question: "What real use is this course to me?"

The answer for the student who intends to major in a science is obvious. His hope is to derive information to use as a tool in making a living.

There is an answer, however, beyond the fact that the course may be required.

The period of the teens and early twenties is a crucial one in life. It is during this time that the student is approaching intellectual and emotional maturity and is physically in his prime. It is also at this time that he is striving to discover what meaning and purpose there may be in life; he is about to come to the conclusion that other people actually exist as important entities rather than adjuncts to his personal welfare; and it is now that with freshly opening eyes he seeks to put the world into an understandable perspective. At no other time than this is the mind so supple and so capable of amendment.

If there is any real lack peculiar to the age, it is the lack of all kinds of experience. Years at college should provide the social and personal experiences to fill this gap. The first year at college may also be one of keen disillusionment, as the student discovers that the professors are not the gods who hold the final answers to all being and meaning in their august persons.

The particular and important service that the chemistry teacher can make is the contribution of facts to the building materials of personal philosophy. Certainly, the best and finest house requires the most materials for its construction, and the most complete and satisfactory of personal philosophies must be housed in a framework of fact, however gaudily it may later be decorated with the furniture of speculation.

This we can do: provide the student with some ideas concerning the structure of matter, the finiteness of the kinds of matter, and the changes matter can undergo. To this, it is hoped, may be added an appreciation for the orderliness of nature and simple laws which govern the infinite proliferation of her works. One should be careful to present known facts as the facts of experience and experiment and stress the idea that the guiding light of theory must be confirmed by the bench of physical manipulation.

Words and Word-Combinations to Be Memorized

be about, age, beyond, certainly, conclusion, fill, framework, fresh, gap, govern, guide, infinite, intend, lack, major, other than, person, philosophy, purpose, real, service, tool

Ex. 5. Give the Russian equivalents for the following:

intend to do smth., derive information, make a living, the period of the teens, a crucial period, intellectual maturity, be about to conclude, personal welfare, be capable of amendment, the lack of all kinds of experience, years at college, fill the gap, provide smb. with smth., to undergo changes, the orderliness of nature, guiding light of theory, physical manipulation

Ex. 6. Give the English equivalents for the following:

выбирать профессию, курс общей химии, очевидный ответ, надежда получить информацию, цель в жизни, личное благополучие, недостаток опыта, важная услуга; идеи, касающиеся структуры вещества; простые законы, следует быть осторожным, представлять факты как..., подчеркивать мысль, подтвердить факт, удовлетворительное объяснение

Ex. 7. Fill in the blanks with articles where necessary.

1. ... student hopes to derive ... information to use as ... tool in making ... living. 2. ... period of the teens and early twenties is characterized by ... lack of all kinds of ... experience. 3. ... first year at ... college may be ... period of ... disillusionment. 4. ... student discovers that ... professors are not ... gods. 5. ... chemistry teacher can provide ... student with some fundamental ideas concerning ... matter.

Ex. 8. Give synonyms for the following:

actual, aim, apparent, obtain from, come nearer, too, find out, try to, give, of course, nice, thought, emphasize, lead

Ex. 9. Give antonyms for the following:

ask, late, come, now, with, excess, best, earlier, careless, finite

Ex. 10. Translate the sentences into Russian.

1. The methods emplyed depend upon the system under consideration. 2. It is owing to the dissociation of acetic acid that the solution becomes alkaline. 3. Discussed in the preceeding chapter is the behaviour of systems formed of two components. 4. It is not improbable that the ratio of the concentrations of a given substance, distributed between two phases, will be constant. 5. It is not until the solution forms a column of height *h* that water enters the tube. 6. Neither can one suppose that the vapour obeys the law. 7. Sodium acetate in water does undergo a partial decomposition. 8. Given in the following table are the values of the solubility. 9. To be sure, the most interesting thing about the conduct of hydrogen is its affinity for oxygen. 10. Putting it another way, the reverse process to that of oxidation is called reduction. 11. Although there can be at least as many alcohols as there are hydrocarbons, only a few of these are of importance. 12. Generally speaking, not all chemical reactions are accompanied by a release of energy. 13. Kinetically, chemical activity is due to collisions of the molecules of the reacting substances. 14. Surprising as it may seem, compounds containing the sodium ion are almost certain to be soluble. 15. The greater the acidity, the greater is the capacity for holding anions. 16. To sum up, the halogens, as a group, form one of the most striking examples of family relationship found in the periodic table. 17. Generally speaking, it is among the spontaneous

processes of nature, many of them chemical, that we find energy for doing our work. 18. A change in velocity is called an acceleration. 19. The greater the applied force, the greater the change in velocity — that is to say, the greater the acceleration.

Ex. 11. Translate the sentences into English without using a dictionary.

1. Обычно человек становится студентом, если он надеется заниматься наукой или получить информацию, которую он может использовать, чтобы зарабатывать себе на жизнь. 2. Юность — самый благоприятный период для этого. 3. Иногда в первые годы обучения студент испытывает разочарование. 4. В этом случае желательно подумать, правилен ли был выбор профессии. 5. Одна из основных целей образования — ознакомиться с фундаментальными теориями и новыми идеями в избранной области.

Ex. 12. Answer the following questions:

1. What question do students often ask themselves? 2. Why is the period of the teens and early twenties regarded as a crucial period of one's life? 3. Why may the first year at college be the period of disillusionment? 4. What service can the chemistry teacher make? 5. What knowledge is the chemistry student provided with?

Section II

Упр. 1. Назовите значения следующих интернациональных слов:

individual, rational, specific, reality, empirical, analogy, characterize, engineer, literature, ordinary, culture, realistic

Упр. 2. Проверьте, помните ли вы значения следующих слов; если нет, обратитесь к словарю:

virtually, stick, urgent, implication, trouble, web, scaffold, edifice, wise, gain, acquisition, sink (sank, sunk), environment

Text 36 B

Прочтите текст про себя (контрольное время чтения — 3 минуты).

Why Study Chemistry?

Certainly, the student who has had one year of chemistry remembers virtually no detail after a few months. The things that stick will generally include some notion of atomic structure, and this information will be of some help to the individual in forming a rational philosophy and in understanding the very urgent implications of atomic power sources; but if this is to be all the student gains we may well be troubled.

It is easy to attack any specific course as contributing little or nothing that the student will use after graduation. However, the huge reality and meaning of education lie precisely in that web of concepts and attitudes which have no meaning without factual detail. It is of no importance that the scaffolding of empirical facts disappear after the edifice we call education has been erected.

It is not wise to press the analogy too far. Beside this complex of attitudes and ideas we have called philosophy, or education, there is necessarily gained by the student a good deal of knowledge which might be characterized as off-hand knowledge in the sense that it is immediately present and usable whenever called up. Such is the knowledge the engineer uses in the practice of engineering and his information in the arts and literature which he may use in ordinary conversation. This immediately available information is tool and culture material and its acquisition is defensible.

But what of that information which has been lost unused, is other than scaffolding? The answer is that it has not been lost. Material which has sunk below the level of recall may be much more easily relearned and understood than brand-new material. The foundations have been built and lie in readiness for the possible time when a particular skill is to be developed. This non-recall information is thus not useless, even though a great part of it be unused. It might be pointed out that even tool information is largely sunk below the level of recall. Especially in chemistry, though a man has a million facts in his head, he still needs the reference literature.

The unique value of a course in chemistry is that it is the only course taken by the great majority of students in which they learn the structure and behaviour of the matter of which their environment is composed. Each knowledge is of primary importance in the development of any realistic philosophy or the understanding of nature.

Упр. 3. Передайте основное содержание текста в нескольких предложениях.

Упр. 4. Какие слова в тексте означают «знания, которые всегда с тобой»?

Упр. 5. Найдите в тексте ответы на следующие вопросы:

1. Does the student remember everything he learns? 2. What may any specific course be criticized for? 3. What kind of knowledge does the student gain? 4. What may be the example of off-hand knowledge? 5. What is the use of information which seems to be lost? 6. What is the unique feature of a course in chemistry?

Упр. 6. Закончите следующие предложения:

1. We may be troubled if... 2. The essence of education is... 3. The foundations lie in readiness... 4. Though a person has a million facts in his head, he... 5. Chemistry course is of primary importance because...

Section III

Ex. 1. Make up short dialogues according to the example.

Example:

— Ah, good evening, Mike! I never see you at the faculty nowadays.
— Yes, we used to meet on Wednesdays, but now my timetable has changed.
— Has it?
— Yes, now I have classes in St. Petersburg, not here on Wednesdays.
— I see.

Ex. 2. Respond to the following statements:

1. Choosing a profession is not an easy thing, you know. 2. As for me, I like chemistry most of all. 3. I'm sorry to say, but I forget a lot of what I learn.

Ex. 3. Give detailed answers to the questions.

1. What do people expect to gain from education? 2. Why is it necessary to learn even those things which won't be used immediately? 3. Why is chemistry one of the most useful professions?

Ex. 4. Discuss the following topics:

1. Possible Ways of Choosing a Profession.
2. The Purpose of Higher Education.
3. Chemistry as a Profession.

TRANSLATION PRACTICE
Texts

Text 1

Conductance and Electrolysis

Generally speaking, the classification of a substance as a non-electrolyte or as an electrolyte is based on the conductance of its aqueous solution. Aqueous solutions of non-electrolytes do not conduct an electric current to any greater extent than pure water does, whereas aqueous solutions of electrolytes conduct an electric current and undergo electrolysis. Weak electrolytes give solutions which are relatively poor conductors because of a limited degree of ionization. On the other hand, aqueous solutions of strong electrolytes readily conduct an electric current.

If a strong electrolyte is formed as a result of a chemical reaction involving two weak electrolytes, the conductance of the resulting solution increases. If the ions of a strong electrolyte are removed from solution as an insoluble precipitate, or from a weak electrolyte with the ions of another reactant, the conductance of a mixture of the reactants is less than that of the strong electrolyte. After the reaction is complete, the conductance will increase upon further addition of the second reactant, provided the latter is a strong electrolyte.

Electrolysis always accompanies the passage of a direct current through an aqueous solution. Cations are reduced to a lower oxidation state, some of them to the free state, at the cathode; anions are oxidized to ions with a higher oxidation state, or to the free state, at the anode.

Text 2

Library and You

Because of the vast accumulation of data, today's student of chemistry must rely on the literature more than ever before; it is therefore to his advantage to become acquainted with the organization and proper use of the chemical literature at the earlier stage of his training. A good way of

helping him to accomplish this in an informal fashion is to encourage him to acquire for his own collection a core of reference books. A great number of undergraduates as well as graduate students are not aware of the wealth of information available in basic reference tools such as dictionaries and handbooks, simply because they are not in the habit of regularly consulting them. By owing a number of these relatively inexpensive reference tools, the student will have a great deal of information at his fingertips, and through constant use of it will develop good library habits which will not only benefit him throughout his professional career but also reduce his tendency to memorize material which he can readily obtain from these books.

Text 3

Infrared Spectroscopy

Infrared spectroscopy resembles Raman spectroscopy in that it provides information on the vibrational and rotational energy levels of a species, but it differs from the latter technique in that it is based on studying the light transmitted *through* a medium after absorption, and not that *scattered* by it.

The techniques of Raman and IR spectroscopy are generally considered complementary in the gas and solid phases because some of the species under study may reveal themselves in only one of the techniques. Nevertheless, it must be stressed that Raman scattering is not affected by the aqueous medium, whereas strong absorption in the infrared shown by *water* proves to be a troublesome interfering factor in the study of aqueous solutions by the IR method.

Text 4

Nuclear Magnetic Resonance

The nuclei of atoms can be likened in some respects to elementary magnets. In a strong magnetic field, the different orientations that the elementary magnets assume correspond to different energies. Thus, transitions of the nuclear magnets between these different energy levels correspond to different frequencies of radiation in the short-wave, radio-frequency range. Hence, if an electrolytic solution is placed in a strong magnetic field and an oscillating electromagnetic field is applied, the nuclear magnets exchange energy (exhibit resonant absorption) when the incident frequency equals that for the transitions of nuclei between various levels.

Were this NMR to depend only on the nuclei of the species present in the solution, the technique would be without point for the identification of species in a solution. But the nuclei sense the applied field as modified by the environment of the nuclei. The modification is almost exclusively due to the nuclei and electrons in the neighbourhood of the sensing nucleus, i. e., due to the adjacent atoms and bonds. Thus, NMR studies can be used

to provide information on the type of association between an ion and its environmental particles, e. g., on ion-solvent interactions or ion association.

Text 5

Gold

Perhaps no other metal has played such an important part in the destiny of man as gold has. For centuries, it has stood as a barometer of wealth and nobility. To secure it, men have fought, suffered and died. Countries have been founded through the search for it; kingdoms have been lost because of it.

Why?

Well, we can supply three reasons. Value. Beauty. Permanence. Obviously, there is a limited supply of the metal available which increases its value. The fact that it is usually found free in nature makes it easy to mine — if you can find it. That it is attractive, we cannot deny. There are very few people who do not appreciate the warm, shining yellow beauty of gold. (We would greatly appreciate having some.) And, finally, its appearance is quite permanent. Aluminium becomes dull, iron rusts, copper corrodes, silver tarnishes, but gold remains the same. (Although, it must be dusted occasionally.)

Despite our glowing words above, metallic gold has very few practical uses. It is really a metal to be looked at, not to be used, about its only use at present is in the manufacture of jewellery. And even then it must be alloyed with other metals, usually copper or silver, as it is too soft to be used in the pure state.

Gold is inactive and is not attacked by oxygen or ordinary acids. It does, however, react readily with chlorine to form gold (auric) chloride, $AuCl_3$. Thus, we can dissolve it in aqua regia or chlorine water, both of which supply chlorine.

It is owing to its remarkable properties that gold as well as platinum are increasingly used in some fields where particular accuracy and reliability are needed.

Text 6

Actinium

Radioactive transition metal of Group III. Atomic number 89. Symbol Ac. All isotopes are radioactive; atomic weight tables list the atomic weight as [227], the mass number of the most stable isotope.

Actinium is exclusively tripositive and resembles the tripositive rare earth elements in its chemical properties. It forms insoluble compounds of the same type as the *lanthanide* elements, such as the fluoride and oxalate. The hydroxide is also insoluble. The similarities to the lanthanides appear in the crystallization of double salts, such as, for example, with magnesium

nitrate, where actinium follows the lanthanides and is very difficult to separate from them. Differences from the lanthanides are to be found in the extent to which complex ions are formed, actinium being, in general, less easily subject to complex ion formation than any of the lanthanide elements. This is presumably related to the basic or electropositive character of actinium, a consequence of its larger ionic radius, and it appears that actinium is more basic than even lanthanum. Actinium goes with cerium group of rare earths in those separations in which the yttrium group is separated with the help of complexing agents. The successful separation of the lanthanide elements from each other by use of the ion exchange resins is also applicable to the separation of actinium from the lanthanide elements and the heavier tripositive actinide elements.

Except for the sulphide, the compounds of actinium are colourless. All of the pure compounds of actinium which have been prepared and whose structures have been determined are isostuctural with the analogous lanthanide and actinide compounds and in each the actinium is tripositive. In addition to the solid halides and oxyhalides, a number of other compounds such as sesquioxide, sulphide, phosphate, oxalate, and a double salt with potassium sulphate have been prepared.

Text 7

Radiation Effects on Polymers

Radiation exerts two opposing effects on polymers. On the one hand, it breaks up the polymer molecules into smaller pieces. On the other, it causes liberation of a hydrogen atom from each of the two adjoining molecules with formation of a link between the two molecules (cross-linking). The existence of cross-links in a polymer makes the material tougher and higher melting and is very desirable for certain applications.

The cross-linking of polymers by radiation has been much studied. The irradiation of any organic compounds results in breaking of CH bonds, leaving free bonds on the carbon atoms while the hydrogen atoms go off together in pairs to form hydrogen gas. In a liquid the resulting free radicals can diffuse as a whole through the solution and eventually meet together and combine. In a solid polymer it is not clear how these centers get together. One proposed mechanism is that a hydrogen atom from a neighbouring carbon will pop into the vacated hydrogen space, producing a new free bond on the atom adjacent to the original free bond position. This process will continue, with the free bond flowing up and down the chain, until the free bond happens to find itself next to a free bond formed on the adjacent molecule which is likewise travelling up and down. Another mechanism, possible perhaps only with amorphous polymer, is that the long-chain molecules as a whole may move with respect to one another until the free bonds find themselves in proximity.

Whatever the mechanism of cross-linking may be, the result is of commercial value.

Text 8

A Metal that Doesn't Sink

A little plate of greyish metal was as light as a chip of wood and didn't sink in water. It was a sample of a magnesium-lithium alloy developed at the A. Baikov Metallurgy Institute of the USSR Academy of Sciences.

Silver-white magnesium is lighter than aluminium and superior to it in heat capacity and in its capability to act as the main component of various structural materials. It is, in fact, 1.5 times lighter than aluminium and 4.5 times lighter than iron. It doesn't give off sparks from friction or on being struck, and is easy to work and weld with, electrically or using gas. Magnesium is also one of the most widespread metals. Its resources are dozens of times higher than those of nickel, zinc, and lead.

As for lithium, the third element on the Mendeleyev periodic table, it is the lightest of all metals. Everything new and unusual appearing today in metallurgy, chemistry, and power-engineering is to a large extent connected with lithium. Scientists, engineers and inventors place great hopes on it.

According to expert opinion, there is much more lithium in the earth's crust than, say, zinc or tin, 130 times more than cadmium and 160 more than antimony. Another interesting fact: over the past 25 years alone, the production of lithium metal in the West has increased 100-fold. Obviously, there is no shortage of lithium in the world.

The installation used to produce magnesium-lithium alloys is an electrically-heated crucible. After definite proportions of magnesium and lithium foundry pigs are put into it, the crucible is hermetically sealed and all air pumped out of it. Then the crucible chamber is filled with argon, an inert gas. Melting, pouring and cooling are all done in an airless medium.

The new alloys will be widely used in these branches of engineering where lightweight metals are required to produce machine parts, equipment, instruments, and household articles.

Text 9

Insulator Turns into Superconductor

Having used ultrahigh pressures and critically low temperatures, scientists at the Institute of High Pressures of the USSR Academy of Sciences have managed to effect such a unique transformation as converting a sulphur insulator into a superconductor...

Superconductivity, at which a conductor completely lacks resistance to electric current, was discovered more than 70 years ago. This phenomenon occurs at temperatures around –273°C.

Present-day electronic, electrotechnical apparatuses, instruments and machines have been developed, operating on superconductors under

conditions of low temperatures. Among them are radio-receiving devices for detecting weak signals arriving from the depths of outer space, highly efficient powerful, and yet small, current generators, transformers and cables.

The equipment that uses superconductors is expensive and is not available for users at large. That is why scientists are looking for materials which would become superconducting at a temperature of, for example, liquid hydrogen, which is –252°C, or liquid nitrogen, which is –196°C. Sulphur has been quite unexpectedly found among the superconducting materials.

The main unit of this installation is a high-pressure chamber. It contains two anvils of synthetic polycrystalline diamond, "carbonado" or black diamond. The surface of one anvil is flat, whereas the other one is shaped as a cone. When compressed, the anvil point develops a pressure of half a million atmospheres! Under such conditions sulphur converts to a "metallic" formation. "Metallic sulphur", cooled by liquid helium, acquires superconducting properties at a temperature of –269°C.

Experiments are being continued and have so far yielded interesting results. Sulphur has increased the temperature of coversion into a superconducting material to –242°C.

Up to now a champion in high temperature superconductivity has been a niobium-to-germanium compound. Its conversion temperature into a superconducting state was –250°C. Now the leadership has passed over to sulphur.

Text 10

Salt Shaker Wedding

On Friday evening, April 13, at five o'clock, Miss Chlorine Halide became the bride of Mr. Sodium Alkali in a double beaker ceremony at the Little Church of Mother Nature. Rev. Electro Valence performed the ceremony.

The bride was given in marriage by her uncle, Mr. Argon Inert, one of the community's most prominent bachelors. The bride's eldest sister Miss Iodine Halide, was her maid of honour. Misses Bromine and Fluorine Halide were bridesmaids; little Master Eka-Caesium was the ring bearer.

Mr. Alkali chose his best man his brother, Mr. Potassium Alkali. Messers Lithium, Rubidium, and Caesium Alkali were ushers. The bride was never lovelier than in her wedding gown of white cellulose acetate which blended perfectly well with her blond beauty. The maid of honour wore a steel-blue-grey gown of viscose. The bridesmaids were gowned in reddish-brown and yellow, respectively.

Following the ceremony, a reception was held at the Electrolytic Tea Room for the immediate family. Brine and carbohydrates were served.

The former Miss Chlorine Halide is a graduate of Anode High School and Electronic College, where she was a member of the Beta Ray Society.

At present, she is connected with Valence's Mill where she is head bleaching agent.

Mr. Sodium Alkali is a graduate of Cathode High School and Cation College, where he was active in athletics, particularly swimming. Mr. Alkali has travelled extensively on land, sea, and in the air. During the war he had the honour of serving his country in the Army, Navy, Marine Corps, and Air Corps. In civilian life the groom holds a prominent position with the Electrochemical Metallic Company.

After the reception the couple left for the Great Salt Lake Region of the United States where they will make their home among their many friends.

Text 11

The Role of Theory in Chemistry

We start at the beginning and define *science* as a set of observations and theories about observations. We then define *theory* as a device for making predictions and correlations of observations. A theory is composed of *axioms*, which are not necessarily self-evident, *procedure*, and the *output* of the procedure. The axioms identify the system, select the procedure and its parameters, and interpret its output. Each theory is judged by the following *pragmatic criteria* listed in the order of decreasing importance.

How diverse is it?

How accurate is it?

How simple is it?

Like all science, theories evolve; they do so because the basis of our scientific knowledge is constantly changing. The *best* theory at a particular point in time is the theory that best satisfies the above criteria. It is not to be judged on a political or a religious basis.

A theory evolves. The axioms are conceived in the mind of the theorist who also may double as an experimentalist. The output of the theory are predictions and correlations that may suggest new experiments to the experimentalist. The predictions and correlations are then compared with observations. If the agreement between predictions-correlations and observation is "good" the theory is a "good" theory, which is a pragmatic value judgement. If the agreement is poor — which occurs sometimes because new observations have been made — a better theory must be found by some theorist generating new axioms and a new cycle. This axiomatic-cum-pragmatic (ACP) cycling is continued until the agreement between theory and experiment becomes "good". We call this process the ACP *epistemology of science* because (1) *epistemology* is the acquisition and validation of knowledge and (2) we wish to distinguish our simplistic view from the more erudite views of the professional philosophers.

The ACP epistemology can be applied to areas outside of science.

Theories of Matter

There is a wide variety of chemical and physical theories from which we select as our example theories of matter (atoms, molecules, solids, nuclei, and elementary particles). We can illustrate the ACP epistemology with the familiar ball-and-stick theory of molecules. This theory employs sticks and coloured balls with holes drilled in them at prescribed angles. The procedure consists of assembling the balls and sticks into figures in all possible ways. The predictions of the theory include molecular geometry and the number of isomers expected for the molecule in question. We all feel comfortable with this ball-and-stick theory because it operates in the three-dimensional, classical world of our senses and seems "real" to us. While it is a very useful theory, it has a number of significant failures. For example, it fails to predict both the geometry and the number of isomers of benzene. More seriously, it fails to predict the electronic, vibrational, and rotational spectra of molecules. This failure to predict spectra is common to all classical theories and has made necessary the development of a new theory which includes predictive powers in this area. The nonclassical *quantum theory* is a theory that predicts more diversely, more quantitatively, but not more simply than the ball-and-stick theory.

Quantum theory has two essentially equivalent versions: one concerned with wave mechanics (derived from Schroedinger's work) and one concerned with matrix mechanics (due to Dirac-Heisenberg) which is our choice. The procedure of the *matrix mechanics theory of matter* (MMTM) is very interesting but is not relevant to the application of the procedure. It employs vector space and their bases, operators, matrices, secular equations, eigenvectors, eigenvalues, groups, group algebras, etc., concepts that are well known to mathematicians but essentially unknown to beginning physicists and chemists. In consequence MMTM may seem less "real" to these beginners than the classical ball-and-stick theory. The MMTM procedure can be applied uniformly to atoms, molecules, solids, nuclei, and elementary particles. It is clear that the concept of *structure* is much simpler and more intuitive in the ball-and-stick theory than in the MMTM theory. The MMTM structure concept is that of a set of building blocks (basis vector of a vector space) that are assembled under supervision of the Hamiltonian into a physically significant set of *structures* (eigenvectors to the Hamiltonian).

The numerical and algebraic calculations required in the MMTM procedure can become quite tedious but fortunately many of them have been or can be programmed for personal computers. The calculations of MMTM then become trivial and operational familiarity is quickly acquired. Consequently, the challenging part of MMTM becomes the selection of the vector space and the Hamiltonian and then the interpretation of the output.

Molecular Theory

Matrix mechanics theory of matter (MMTM) is a better molecular theory than the ball-and-stick molecular theory. In the *ab initio* MMTM *molecular theory* the only parameters required by the procedure are Planck's constant, the charge and mass of the electron, and the number and kind of nuclei. This theory can for many molecules predict with high accuracy their equilibrium geometries and their force constants. Unfortunately it predicts other properties, e. g., dissociation energy, electronic spectra, etc., with a lower accuracy. The accuracy can be increased by the use of larger vector spaces, a technique that can be very difficult, very expensive, and/or impossible with the currently available scalar computers. The problem becomes easier with supercomputers that employ vector and/or parallel processors and larger memories, but there will always be some upper limit to the size of a molecule on which accurate *ab initio* calculations can be made. A theory which is less strongly computer-dependent is the *semiempirical molecular theory*. Its procedure employs a smaller vector space and its parameters are determined by comparison of predictions with a small number of observations.

An example of a semiempirical molecular theory is the *π-electron theory* of conjugated, unsaturated hydrocarbons. Here the size of the vector space is reduced by ignoring core and δ-bonded electrons and employing a single π-orbital for each carbon site. The size of the vector space can be further reduced by the use of either of two more approximate theories: the *π-Hückel molecular orbital theory*, which resembles the Bohr theory of the atom, and the *π-valence bond theory*, which resembles the ball-and-stick theory.

Text 14

Differentiating between Primary, Secondary, and Tertiary Alcohols

A primary or secondary aliphatic alcohol dissolved in pure glacial acetic acid *decolourizes* a water solution of $KMnO_4$, while a tertiary alcohol *fails to do so*. A secondary alcohol will continue to react with $KMnO_4$ solution if a little concentrated sulphuric acid is added, while a primary alcohol does not. By means of those reactions one may distinguish between primary, secondary, and tertiary alcohols of the paraffin series. Further, no more than one drop of the alcohol is necessary to make the test, which fact should make it especially interesting in investigations where only small quantities of alcohol are available.

A convenient procedure is as follows: A 4-inch test-tube is fitted with a one-hole rubber stopper carrying a glass rod which reaches to the

bottom of the test-tube. Glacial acetic acid (3 ml.) is introduced into the test-tube, and then one drop of the pure unknown is added. A saturated, filtered solution of $KMnO_4$ in water is added, a drop at a time, to the contents of the tube, with stoppering and vigorous shaking between each addition.

If no decolourization of the $KMnO_4$ takes place, the alcohol is tertiary. If decolourization takes place (best ascertained from time to time by spotting the mixture by means of the glass rod into filter paper), the addition of $KMnO_4$ is continued a drop at a time until the pink colour of $KMnO_4$ persists. When decolourization has ceased to take place, a drop of concentrated H_2SO_4 is added and the addition of $KMnO_4$ with shaking is continued. If the pink colour is not discharged under these conditions, the alcohol is primary. If decolourization proceeds again after the addition of H_2SO_4, followed by a final permanent pink colour, the alcohol is secondary.

It is advisable to run a blank test of the glacial acetic acid used, because some glacial acid samples contain extraneous materials which react with $KMnO_4$ solution.

This method has been found reliable for all aliphatic alcohols through the amyl group. Whether it can be extended to other classes of alcohols has not been determined.

To the student in the laboratory it would seem that this different approach to the differentiation of the alcohols would be much more simple and direct than the Lucas test currently in manuals.

Text 15

A Brief History of Polypeptide Chemistry

Protein chemistry really began in the 1830s with Mulder's systematic investigation of nitrogenous biological materials, such as blood fibrin, egg white, gelatins, and silk. In 1840, Hünefeld was the first to crystallize a protein — viz., hemoglobin. During the following 90 years, amino acids, the building blocks of protein, were isolated by many investigators, but for many years it was not realized how amino acids were linked to form proteins. In fact, it was not until 1902 that Fisher and Hofmeister independently proposed that amino acids were joined together by peptide bonds (—CO—NH—).

It was not the early work on protein chemistry, however, that led to the concept of enzymes as catalysts of biological reactions. Indeed, it was the early research on fermentation of Lavoisier in the later 1700s and the subsequent work by Schwann, Pasteur, and Buchner between 1830 and 1900 that led to the development of this concept. Once the role of enzymes was realized, scientists, uncluding Harden and Young, Emboden and Meyerhof, Krebs, Lynen and Lipmann, were eventually able to formulate the individual steps of most of the metabolic processes in the body.

In 1926, Sumner made a tremendous advance when he recognized that enzymes were, in fact, proteins. He came to this conclusion after he had successfully crystallized a protein *that was associated with enzymatic activity* (viz., urease) and noticed that the degree of degradation of this highlypurified protein could be correlated with the disappearance of the associated enzymatic activity. Before that time, it was thought that enzymes might be special nonprotein substances that happened to be associated with proteins. In other words, it was thought that some proteins might simply serve as passive, structural supports for enzymes. On the other hand, Sumner's discovery suggested that the enzymatic activity was related to the structure of the protein per se. In the 1930s Northrop and Kunitz purified and crystallized many enzymatic proteins and, thus, confirmed Sumner as the father of modern enzymatology.

Text 16

Characteristics of Mössbauer Spectra

To obtain a resonant gamma-ray absorption spectrum it is necessary to relate the transmission intensity to the instantaneous source-absorber velocity. In practice there are a number of methods which can be used to accomplish this, and these can be roughly divided into two groups: those which employ constant velocity drives and those which employ continuously reliable velocity drives. The characteristics and advantages of each of these systems have been discussed in detail by Wertheim and elsewhere. In the present discussion we shall not explore any of these methods in detail, but will concern ourselves only with the details of the spectra which are obtained.

A typical Mössbauer spectrum is a characteristic plot of the total number of events (counts) observed as a function of source-absorber velocity (the standard convention is to represent motion of the source toward the absorber by positive velocities and motion of the source away from the absorber by negative velocities).

The profile of the resonance maximum obeys (ideally) the Lorentz relationship:

$$I(E) = \frac{\text{constant}}{(E - E_0)^2 + {}^1\!/_4\,\bar{\Gamma}^2}$$

in which E_0 is the Doppler energy (in the velocity units) at resonance maximum. Since the resonance line which is observed in a measure of the overlap of two lines of width r, the measured full width at half maximum is $2\,\bar{r} = \bar{\Gamma}$.

The parameters of the Mössbauer spectrum which are of greatest interest to a chemist are the magnitude of the resonance effect (ε), the line width ($\bar{\Gamma}$), the isomer shift (IS), the quadrupole splitting (QS), magnetic hyperfine structure (mhfs), line asymmetry, and temperature coefficients of these parameters.

Text 17

Free Radicals

An atom or group of atoms with one or more unshared electrons, which may enter into chemical-bond formation is called a *free radical*. (The same group in a molecule is called a radical; for example the methyl radical in methyl cyanide or other molecules.) Free radicals are usually highly reactive and difficult to prepare in any except low concentration.

One way of making the methyl radical as a dilute gas is by heating mercury dimethyl, $Hg(CH_3)_2$, which decomposes to give metallic mercury and methyl radical. Methyl radical can also be made conveniently by the decomposition of diacetyl, $(CH_3CO_2)_2$, by either heat or ultraviolet light. The diacetyl molecule liberates two molecules of carbon dioxide and two methyl radicals.

The American chemist Moses Gomberg (1866–1947) discovered in 1900 that some hydrocarbon free radicals are stable. He attempted to synthesize the substance hexaphenylethane, $(C_6H_5)_3C—C(C_6H_5)_3$, which he expected to be a stable, white crystalline substance. Instead, he obtained a strongly coloured solution, with the property of combining readily with oxygen. He concluded correctly that the solution did not contain the hexaphenyl derivative of ethane, but instead, the free radical triphenylmethyl, with the formula $(C_6H_5)_3C^{\cdot}$. Many similar hydrocarbon free radicals have been made, and it has been shown that they are paramagnetic, and accordingly contain unpaired electrons (the paramagnetism is due to the magnetic moment of the electron spin of the unpaired electron). The stability of the triphenylmethyl radical, which is responsible for the low bond energy of the carbon-carbon bond in the substituted ethane, is attributed to the resonance energy of the unpaired electron among the various carbon atoms of the molecule.

Text 18

The Manufacture of Sulphuric Acid

It is a matter of common knowledge among chemists that sulphuric acid is made by two processes, the *contact process* and the *lead-chamber process*, which are now about equally important.

In the contact process sulphur trioxide is made by the catalytic oxidation of sulphur dioxide (the name of the process refers to the fact that reaction occurs on contact of the gases with the solid catalyst). The catalyst formerly used was finely divided platinum; it has now been largely replaced by vanadium pentoxide, V_2O_5. The gas containing sulphur trioxide is then bubbled through sulphuric acid, which absorbs the sulphur trioxide. Water is added at the proper rate, and 98% acid is drawn off.

In the lead-chamber process oxygen, sulphur dioxide, nitric oxide, and a small amount of water vapour are introduced into a large lead-lined

chamber. White crystals of nitrosulphuric acid, $NOHSO_4$ (to put it in another way, sulphuric acid in which one hydrogen ion is replaced by the nitronium ion, $:N\equiv O^+:$), are formed. When steam is introduced the crystals react to form drops of sulphuric acid, liberating oxides of nitrogen. In effect, the oxides of nitrogen serve to catalyze the oxidation of sulphur dioxide by oxygen. The reactions that occur may be summarized as

$$2SO_2 + NO + NO_2 + O_2 + H_2O \rightarrow 2NOHSO_4;$$

$$2NOHSO_4 + H_2O \rightarrow 2H_2SO_4 + NO + NO_2.$$

The oxides of nitrogen, NO and NO_2, that take part in the first reaction, are released by the second reaction, and can serve over and over again.

It should be pointed out in conclusion that however widespread these processes may be, they are by no means the only ways of the manufacture of sulphuric acid.

Text 19

What Is Light? What Is an Electron?

During recent years many people have asked the following questions: "Does light *really* consist of waves or of particles? Is the electron *really* a particle, or is it a wave?"

These questions cannot be answered by one of the two stated alternatives. Light is the name that we have given to a part of nature. The name refers to all of the properties that light has, to all of the phenomena that are observed in a system containing light.

Some of the properties of light resemble those of waves, and can be described in terms of a wave length. Other properties of light resemble those of particles, and can be described in terms of a light quantum, having a certain amount of energy, $h\nu$, and a certain mass, $h\nu/c^2$. A beam of light is neither a sequence of waves nor a stream of particles; it is both.

In the same way, an electron is neither a particle nor a wave, in the ordinary sense. In many ways, the behaviour of electrons is similar to that expected of small spinning particles, with mass — m, electric charge — e, and certain values of angular momentum and magnetic moment. But electrons differ from ordinary particles in that they also behave as though they had wave character, with wavelength given by the de Broglie equation. The electron, like the proton, has to be described as having the character both of a particle and of a wave.

After the first period of adjustment to these new ideas about the nature of light and of electrons, scientists became accustomed to them, and found that they could usually predict when, in a certain experiment, the behaviour of a beam of light would be determined mainly by its wavelength, and when it would be determined by the energy and mass of the photon; that is, they would know when it was convenient to consider light as consisting of waves, and when to consider it as consisting of particles, the photons.

Similarly, they learned when to consider an electron as a particle, and when as a wave. In some experiments the wave character and the particle character both contribute significantly, and it is then necessary to carry out a careful theoretical treatment, using the equation of quantum mechanics, in order to predict how the light or the electron will behave.

Text 20

The Nature of Resonance

The idea of resonance has brought clarity and unity into modern structural chemistry, has led to the solution of many problems of valence theory, and has assisted in the correlation of the chemical properties of substances with the information obtained about the structure of their molecules by physical methods.

The goal of a structure investigation of a system is the description of the system in terms of simpler entities. This description may be divided into two parts, the first relating to the material particles or bodies of which the system is considered to be composed, and the second to the ways in which these particles or bodies are interrelated, that is, to their interactions and interconnections. In describing a system it is usually convenient to resolve it first into the next simpler parts, rather than into its ultimate constituents, and then to carry the resolution further and further in steps. We are thoroughly accustomed to this way of describing the material constitution of substances. The use of the concept of resonance permits the extension of the procedure to include the discussion not only of the next simpler constituent bodies but also of their interactions. Thus the material description of the benzene molecule as containing carbon and hydrogen atoms, which themselves contain electrons and nuclei, is amplified by use of the resonance concept in the following way: The structure of the normal benzene molecule corresponds to resonance between the two Kekulé structures, with smaller contributions by other valence bond structures, and the molecule is stabilized and its other properties are changed somewhat by this resonance from those expected for either Kekulé structure alone; each Kekulé structure consists of a certain distribution of single and double bonds, with essentially the properties associated with these bonds in other molecules; each bond represents a type of interaction between atoms that can be dissolved in terms of the resonance between structures differing in the interchange of electrons between atomic orbitals.

Text 21

Benjamin Franklin and Electricity

January 17, 2006, will be the 300th anniversary of the birth of Franklin.

Kant once remarked that Benjamin Franklin was a new Prometheus who had stolen fire from heaven. In his own day, Franklin was celebrated

throughout all Europe as the world's foremost electrician and his book on the subject was in demand in many countries. Far-reaching in its influence, the book became an important Text in the electrical field and even today we still write of electricity in terms introduced in print by Franklin. Used in the electrical sense, probably for the first time, in the inventor's book were words such as armature, battery brush, charged, charging, condense, conductor, discharge, electrical fire, electrical shock, electrician, electrified, electrify, Leyden bottle, minus, negative, non-conducting, non-conductor, non-electric, plus, positive, and others.

Franklin saw his first electrical demonstration in Boston in 1746. He purchased all the apparatus used by the British experimenter, Dr. Spence, and proceeded in electrical experiments of his own with great interest. The work that he did was soon far ahead of the European discoveries. With great enthusiasm, he described new discoveries that were to him unique, for he had no way of telling what work his predecessors had done. Foremost among the observations was the discovery of the action of points in drawing off and throwing off the electrical fire. One of Franklin's scientific achievements was his experiment with the Leyden jar. He explained the startling discovery that the electrified jar became charged positively on the outside, negatively on the inside, and showed by means of experiment that the positive charge on the outer coating of the jar was exactly equal and opposite to the negative inner charge.

Besides the importance and usefulness of Franklin's discoveries, the world knows him well for his hypothesis concerning the electrical nature of lightning. Up to his discoveries the general impression was that lightning was caused by the explosion of poisonous gases in the air. In 1749, Franklin established that electrical fluid and lightning had similar properties of giving light, colour of the light, crooked direction, swift motion, being conducted by metals, crack or noise in exploding, subsisting in water or ice, rending bodies it passes through, destroying animals, melting metals, firing inflammable substances, sulphureous smell.

Text 22

Future Perspectives

The production of protein from chemicals is not the only process one can employ for converting chemicals to food, but it is representative of one major type of process: fermentation. Microorganisms are able to efficiently produce nutrients, including proteins, fats, carbohydrates, vitamins, etc., with high productivity. With microorganisms, it is possible to intensively convert chemicals to food regardless of climatic variation and environmental pressures. Thus, this route to food production is likely to increase in both developed and developing countries. The needs of the future are to develop more efficient methods of converting chemicals to foods and to develop more applications of the final product. This latter

point is especially important when we remember that "a food is not a food until it is eaten", and it is necessary that someone be willing to buy it before it can be sold. In fact, developments in the area of application are likely to be rate-limiting steps in the utilization of these novel foods.

In addition to protein by fermentation, one can make specific products like essential amino acids (e. g., lysine, tryptophan, and threonine) which may be used to supplement plant protein sources as a way to increase their nutritive value. Again, the limitation is frequently in methods of application and/or economics.

There will continue to be a need to trap our widespread but difficult-to-use resources such as coal and oil shale, and to utilize effectively our renewable resources such as cellulose, as initial starting products for food. Microorganisms are quite unique in that they can take a wide variety of raw materials and sufficiently convert them to foods. In a sense, they represent miniature farms and factories all in one. The future use of these organisms to overcome food shortages lies in the hands of the creative scientist and engineer.

Text 23

Gas Chromatography Methods

Gas chromatography (GC), or, more recently, gas-liquid chromatography, is based on the volatilization of thermally stable analytes which have a vapour pressure of approximately 0.1 mm or greater at temperatures less than 400°C. It is one of the outstanding and more recent methods which have revolutionized the chemical analysis of major and minor components (analytes) for both organic and inorganic analyses. Trace organic analysis comprises the area of greatest application for gas chromatography, but there are several GC techniques available for inorganic pollutants. Some of the inorganic constituents may be relatively involatile and may also be of fairly high molecular weight. Special sampling and processing techniques may be used in such cases, and these include pyrolysis, derivatization, and the indirect analysis of reaction products. A promising area for trace analysis of inorganic constituents involves the conversion of the trace element to a chelate compound or organometallic and subsequent GC determination using electron capture detection. A flame photometric detector can also be used in GC for metal-containing compounds. The time required for chemical analysis using GC is normally from a few minutes to half an hour. However, for some complex samples, the time involved in sample separation, quantitative data reduction, and sample identification can extend for several hours. The accuracy of GC analysis is governed by the sampling and injection procedures, attainable resolution, the detectors and detector calibrations, peak area measurements, and the availability of suitable standards for GC. The precision attainable depends greatly on the particular analytical chemist's experience and also varies for different concentration levels.

In recent years, the versatility of GC has been greatly extended by the so-called ancillary techniques. This refers to the coupling of different instrumental or chemical methods with GC in one unified system. Examples are the coupling of GC with infrared and Raman spectroscopy, mass spectrometry, NMR spectroscopy, thin-layer chromatography, microreactor systems, and pyrolyzers.

Text 24

Liquid Chromatography Detectors

During the last years, there has been a marked increase of interest in column liquid chromatography (LC). One reason that this technique, whose discovery preceded gas chromatography (GC) by many years, has not been used extensively until relatively recently, has been due to the inherent shortcoming of suitable detection devices to times involved. Promising improvements in detector design during the last years, however, have made it possible to use a number of different modes of detection with highspeed, highefficiency liquid chromatographic columns.

High resolution column LC is a technique which is experimentally analogous to GC, in that one makes use of small sample sizes (microlitre quantities), long, narrow bore columns, fast moving liquids, and continuous and highly sensitive detection devices. The term "liquid chromatography" includes several distinct types of interaction, i. e., (1) *liquid-liquid*, in which the components are separated by partitioning between a mobile and stationary liquid; (2) *liquid-solid*, in which the components are selectively adsorbed on an active surface; (3) *ion exchange*, in which ionic components of the sample are separated by selective exchange with replaceable ions of the support; (4) *permeation*, in which separations occur on a permeable gel by a sieving action based on molecular size.

The advantage of liquid chromatography is that thermally unstable, nonvolatile compounds which cannot be eluted by GC, can often be separated by LC, since columns are operated at or near room temperature. Applications therefore seem feasible for such high molecular weight compounds as proteins and polymers. Too, the interchange of solvents can provide special selectivity effects in LC, since the relative retention of two solutes is strongly influenced by the nature of the eluent used. Although LC is not likely to replace GC as an analytical technique, the two methods should complement one another.

The current interest in column LC is evidenced by numerous articles which are now appearing in the literature. Column liquid chromatography has been successfully employed by several workers in the analysis of steroids, herbicides, insecticides, metal organic compounds and biologically active materials. Recently, reports have appeared, describing improvement in performance and efficiency of LC columns by the development of controlled surface porosity supports and by the use of high speeds and high pressures, enabling the technique to become competitive with GC.

Miscellaneous Grammar

Translate the sentences into Russian.

1. The work referred to also brought to light many examples of abnormal behaviour. 2. Having examined it carefully, we found out that the gas under investigation exhibited anomalous behaviour. 3. The abnormal osmotic pressures can be explained by the hypothesis of a hydrolytic decomposition. 4. To conclude, there are two features of high abnormal chemical reactivity. 5. If the temperature is raised, a small amount of phenol must be added in order to produce a separation of liquid. 6. If water is added to ether, solution will not occur. 7. Shown in the following table is the degree of agreement between the two sets of values. 8. The experimental facts we obtained are in agreement with the law. 9. And to sum up, the pressure must be considered in agreement with the modern kinetic theory. 10. If we prepare some HgCd alloys and allow the alloy to reach the ordinary temperature, it will generally solidify provided enough Cd is present. 11. Other conditions being equal, the dissociation theory is in good agreement with these observations. 12. The agreement between the final columns shows the hydrolysis of the salt to have practically disappeared. 13. The results of several methods to be described later are in satisfactory agreement. 14. If a solid be allowed to cool down, it becomes heterogeneous. 15. α- and β-rays were found to consist of pulsations analogous to Röntgen rays. 16. Though somewhat different, analogous behaviour may be observed in the case of the gaseous system. 17. It follows from the above that the case is analogous to a mixture of alcohol and water. 18. Returning to van't Hoff's argument, it will be remembered that the striking feature of his argument is that he actually calculated the normal constant for substances dissolved in a given solvent. 19. To understand Arrhenius' argument more clearly, it is necessary that we should refer to the work of Kohlrauch. 20. The gas law has been seen to apply only to dilute solutions. 21. With the help of the kinetic theory applied to the thermal expansion, one can calculate that the absolute zero is –273°C. 22. Applying the law of mass action, the following equation was obtained. 23. The values given below are calculated on the assumption that 1 gram-molecule of the substance under examination is dissolved in 10 litres of water. 24. This assumption is shown to be quite inadequate. 25. The formula quoted earlier is based on a number of assumptions which restrict its applicability. 26. It has been shown experimentally that this assumption is

a correct one in the inorganic colloids examined. 27. Further assumptions were made about the electrical work required for the vibration of the particles. 28. One has to make separate assumption in each single case. 29. It was on the basis of the electrolytic dissociation theory that the factor *i* was shown later by Arrhenius. 30. It is not uninteresting to note that the subject of osmotic pressure of electrolytes is discussed on the basis of the theory put forward in 1883. 31. One should never forget that the Phase Rule is based on thermodynamical considerations. 32. Unfortunately, this formula is based on a number of assumptions which necessarily restrict its applicability. 33. It should be admitted that the behaviour of matter at –273°C is practically inconceivable to us. 34. The behaviour of gases and, to a less extent, the behaviour of liquids can, thus, be accounted for. 35. The authors were the first to endeavour to investigate the behaviour of liquids and gases from the physical standpoint. 36. The behaviour of several gases has been investigated but no definite conclusion could be drawn. 37. It is not unlikely that when mercury and water are brought together the two liquids will remain side by side. 38. If alcohol and water be brought together, complete miscibility takes place. 39. The relation enables us to calculate *k* quite easily. 40. Lord Kelvin calculated that when the air space between them was 10^{-5} cm, the attraction was 2 grams weight. 41. One can calculate by Gay-Lussac's law, what the density would be. 42. Let us now calculate the equilibrium constant for the above case. 43. It is essential that the case of mixed crystals of thallium nitrate and potassium nitrate should be taken here. 44. Take the case of iodine and benzene. 45. In certain cases, one could find that in the mixed crystal one of the components would have a smaller molecular weight than in the ordinary case. 46. Whatever reasons may be given, Henry's law is a particular case of the distribution law. 47. Whatever considerations may be presented, the case is different with organic colloids. 48. If the experiment be carried out at a very low temperature, hydrogen is found to behave like other gases. 49. The work carried out is based on certain relationships which proved to be incorrect. 50. Unless otherwise specified, the analyses are carried out in an analogous manner. 51. A series of freezing point determinations at various concentrations was carried out which is consistent with the data from the literature. 52. A further addition of phenol causes a second liquid phase to be formed. 53. Refer once more to Figure 2, it is seen therefrom what made the gas concentrate in water. 54. A very striking confirmation of the dissociation theory was afforded by the work of Ostwald on the permanganates in aqueous solutions. 55. Suffice it to say, this has been confirmed in the case of the salts of quinic acid only. 56. It is small wonder that the observed change of degree of dissociation is likewise satisfactory confirmation of the law of mass action. 57. In the present chapter, the systems will be considered in which combination between compounds can occur with the formation of definite compounds. 58. There are three separate curves to be considered in the case of sodium sulphate and water. 59. Consider one molecule moving in a straight line. 60. One might consider

gases simply as systems of small particles. 61. The substance obtained is believed to be either an impure form of Ag_2O_3 or a basic sulphate of tripositive silver. 62. The residue left after most of the liquid air had boiled away consisted largely of oxygen and nitrogen. 63. To obtain phosphoric acid, one must dissolve the oxide of phosphorus in water. 64. To balance an equation, the formulas of all reactants and products must be known. 65. The acidity of solutions is often expressed in terms of pH; the lower the pH, the more acid in the solution. 66. No precipitate forms unless the value of the ion product for the mixture is greater than Kps for the salt being considered. 67. To destroy sulphur compounds, Courtois added sulphuric acid, and on one eventful day in 1811 he must have added it in excess. 68. Bunsen's early cacodyl researches were followed by a study of blast furnace gases. 69. It was not until 1870 that Berthelot began to study the explosive force of powders. 70. Having added the necessary amount of sulphur to bromine and mixed the solution obtained with ice, we obtained hydrogen bromide. 71. Compounds of phosphorus are likely to be reduced by hot carbon. 72. Catalysts accelerate the reactions that otherwise would be too slow. 73. Soon after hearing of the discovery of argon, Lecoq de Boisbaudran predicted that it might belong to a family of absolutely inert elements, all of which were then unknown. 74. Whether our observation is of significance remains to be proved. 75. Should the Sun cease to give us heat, the air and the whole surface of the earth would slowly cool off. 76. The perferrites are rather stable in alkaline media, but when acidified evolve oxygen, the iron being reduced to the tripositive state. 77. These striking properties made him suspect the presence of a new element. 78. For many purposes, it is desirable that water should be pure. 79. Because of the complications introduced by operating at elevated temperatures it was clear that the reaction of silver nitrite with alkyl halides ought to be conducted at as low a temperature as possible. 80. The first step in the reaction appears to be the formation of ferrite, which is followed by atmoshperic oxidation of the iron. 81. Increasing temperatures up to 50° C and high alkali concentration favour ferrate formation. 82. Upon washing these plates with a little distilled water, one obtains the substance in the pure state. 83. For one substance to dissolve in another their molecules must attract each other strongly. 84. Copper and gold oxides are weak bases, the basic character decreasing as the atomic weight rises. 85. The liquid a substance dissolves in is called a solvent. 86. That copper comes off the anode in the tripositive form is confirmed by calculations involving the anodic loss of weight and Faraday's law. 87. The discovery of spectral analysis increased Bunsen's fame enormously and led to his being called to Berlin. 88. Having cooled the concentrated solution of naphthalene in hexane we obtained white precipitate of pure naphthalene. 89. During the remaining years of his life Franhofer continued his studies of spectra without ever realizing the significance of the lines which today bear his name. 90. None of the fourteen colourless gases studied showed lines. 91. It was Berthelot who, starting from the elements, synthesized the various

hydrocarbons. 92. The initial rate is only slightly affected by the acid concentration, or by the ionic strength of the solution. 93. Three products are likely to be formed by the electrolytic reduction at a lead cathode. 94. Experiments similar to those just described were performed in aqueous medium in the presence of various coordinating agents. 95. On adding barium chloride reagent to the reaction mixture white barium sulphate is formed if nitrite is present. 96. It was well known among silver miners that a certain ore found as a white mineral, horn silver, turned dark upon exposure to sunlight. 97. In the early years of the science of chemistry a substance was accepted as an element so long as no reaction showing it to be a compound had been observed. 98. To vaporize means to change a solid into a vapour by heating it. 99. Different elements consist of different kinds of atoms, the most significant being their weights. 100. Mendeleyev's success in working out the Periodic Table was largely due to the exhaustive study he gave to the properties of the elements. 101. The explosion of a mixture of hydrogen and chlorine might have occurred, had the necessary precautions not been taken in time. 102. The policy of some countries seems to favour agriculture more than all other employments, which results in particular development of agricultural chemistry. 103. The cathodic reduction of Yb(III) in a cell of a type similar to that used for the production of dipositive europium results in the formation of Yb(II). 104. The spectroscope shows the outer atmosphere of the Sun to consist largely of hydrogen. 105. Ramsay continued to search for other inert gases, and in this he was aided by his assistant, Morris William Travers. 106. No conclusion can be drawn as to whether chlorination occurred at the 9-position. 107. Three presently unknown ionic species have to be prepared and studied for a complete examination to be possible. 108. When an element exists in more than one form, it is said to be allotropic. 109. To measure any quantity is to compare it with something already known, taken as a standard. 110. This phenomenon is the more pronounced, the more non-homogeneous the metal. 111. Had the method of electrolytic reduction of the nitrobenzene been employed, the yield of aniline would have been considerably higher. 112. To separate the thorium from iron, this precipitate is dissolved in hydrochloric acid. 113. This group being inert to most reagents, it is impossible to hydrolize it. 114. Upon being warmed with concentrated sulphuric acid, the ion is decomposed with the liberation of oxygen. 115. The alkali metals do form positive ions. 116. Hydrogen is placed by itself in the periodic table because its chemical behaviour is not closely similar to that of any other element. 117. It is an experimental fact that two fluorine atoms will combine to form a diatomic molecule F_2. 118. It was while systematizing his ideas for his famous textbook, *Principles of Chemistry*, that D. I. Mendeleyev devised his periodic table. 119. If Avogadro's hypothesis had been accepted, chemists would have been spared half a century of confusion. 120. Titanium seems to combine all the best properties of steel and aluminium with other valuable ones of its own.

Appendices

I

Words a Student Should Know before Studying the Textbook

A

a*
about*
above
active
after
afternoon
  in the afternoon
again
against
ago
agree
all*
along
already
always
American
among
an*
and*
animal
any
  anybody
  anything
April
army
around
arrive
art
artist
as*
at*
  at 5 o'clock
  at the table
August
autumn
  in autumn

B

back
bad (worse, worst)
badly
bag
ball
be* (am*, is*, are*, was*, were*)
  there is..., etc.
  be absent
  be bord
  be going to
  be ill (well)
  be interested in
  be late
  be on duty
  be over
  be present
  be ready
  be sorry
  be ... years old
beautiful
because
become
before
begin
beginning
behind
belong
between
big*
bird
black
blackboard
blue
book
both
box
bread
break
bridge
bring
brother
brown
build
building
bus
  go by bus
busy
  be busy
but*
buy
by*
  by my friend

---

* Здесь и далее слова, помеченные звездочкой, следует выучить в первую очередь.

C

call*
can*
capital
capitalist
car
  go by car
catch
celebrate
central
centre
century
chair
change
child (children)
cinema
circle
city
class
classroom
clean
clear
o'clock
  It is 5 o'clock.
cloud
club
coast
coat
cold
collective
colour
come*
  come in
continue
copy
corner
correct
correctly
count
country
cover
cross
cup
cut

D

daily
dark
day
December
decide
defend
democracy
democratic
demonstrate
describe
desk
die
different
difficult
dinner
dirty
discover
  do* (did*)
doctor
dog
door
down*
dress
drink
during
duty

E

each
early
east
easy
eat
economic
economy
eight
eighty
eighteen
eighth
eleven
eleventh
else
empty
end
England
English
enough
enter
evening
  in the evening
every
  everybody
  everyone
  everything
explain
exploit
eye

F

face
factory
family
far
farmer
father
February
field
fifteen
fifth
fifty
fight
film
find
finish
fire
first*
fish
five
flag
food
football
for*
forest
forget
forty
four
fourteen
fourth
Friday
friend
friendly
from*
  from Moscow
  from 5 to 7 o'clock
front
  in front of
full

G

game
garden
get*
  get acquainted with
  get up
girl

give
glass
go* (went*)
  go away
  go on
  go out
  go to bed
good (better, best)
grammar
grass
great
green
grey
ground
grow

H

half
hand
happen
happy
hard
hat
have* (has*, had*)
  have dinner (supper, breakfast, tea...)
  have a nice time
  have to
he*
hear
heart
heavy
help
her*
here*
high
him*
his*
history
hockey
holidays
home
  at home
homework
hope
hot
how
  how long
  how many
  how much
hundred
hungry

I

I*
if*
in*
industrial
industry
interesting
international
into*
invite
it*
its

J

January
job
June
July
just*

K

kill
king
know

L

lake
land
language
large
last
late
learn
leave
left
lesson
let
  let's (let us)
letter
life
light
like*
listen
little*
live
long
look*
  look out
loud
love
low

M

make*
man (men)
many* (more*, most*)
March
march
May
may*
me*
mean
meat
meet
meeting
member
middle
milk
million
mine
minute
mistake
Monday
money
moon
morning
  in the morning
mother
mountain
move
much*
museum
music
must*
my*

N

name
  What is your name?
  — My name is...
national
near
necessary
need
never
new*
newspaper
next

night
  at night
nine
nineteen
ninety
ninth
no*
nobody
nothing
noon
north
not*
notebook
November
now*
number

O

October
of*
  the book of my friend
off*
often
old*
on*
  on Monday
  on the table
once
one*
only*
open
or*
organize
other*
our*
out*
  out of
over*
  be over

P

page
parents
park
part
party
pay
peace
pen
pencil
people
picture
place
plan
plane
play
pleasant
political
poor
port
prepare
pronounce
pupil
put

Q

quarter
question
quick
quickly
quiet

R

rain
ratio
read
receive
red
remain
remember
rest
rich
right* (2)
rise
river
road
room
round
run
Russia
Russian

S

Saturday
say* (said*)
school
sea
second
see*
sell
send
September
seven
seventeen
seventh
seventy
shall
share
she*
ship
shoe
shop
short
show
side
simple
simply
sister
sit
  sit down
six
sixteen
sixth
sixty
ski
sky
sleep
slow
slowly
small
snow
so*
society
soft
some*
somebody
something
south
speak
spend
sports
spring
  in spring
square
stand
  stand up
star
start
stop
story
street

strong
struggle
student
study
suit
summer
  in summer
sun
Sunday
supper
swim

T

table
take
  take part in
tea
teach
teacher
tell
ten
tenth
that* (those)
the*
theatre
their*
them*
then*
there*
they*
thing
think
third
thirteen
thirty
this* (these)
thousand
three
through
Thursday
ticket
time
to*
  Give the book
    to the teacher.
  Go to the
    blackboard.
today
tomorrow
town
train
tram
translate
travel
tree
try
Tuesday
twelfth
twelve
twenty
two*

U

under
understand
unemployed
unite
up*
use
usual

V

village
visit

W

wait
  wait for
walk
wall
want*
war
warm
wash
watch
water
way
we*
Wednesday
week
weekly
well*
what*
when*
where*
which*
white
who* (whom, whose)
why
window
winter
  in winter
with
  He writes with a pen.
without
will*
woman (women)
word
work
worker
world
write
writer
wrong

Y

year
yearly

II

Chemical Elements

Ac	actinium	[æk'tɪnɪəm]	актиний
Ag	silver	['sɪlvə]	серебро
Al	aluminium	[ˌælə'mɪnɪəm]	алюминий
Am	americium	[ˌæmə'rɪsɪəm]	америций
Ar	argon	['ɑ:gɒn]	аргон
As	arsenic	['ɑ:snɪk]	мышьяк
At	astatine	['æstəti:n]	астат
Au	gold	[gəʊld]	золото
B	boron	['bɔ:rɒn]	бор
Ba	barium	['beərɪəm]	барий
Be	beryllium	[bə'rɪlɪəm]	бериллий
Bi	bismuth	['bɪzməθ]	висмут
Bk	berkelium	[bə'ki:lɪəm]	беркелий
Br	bromine	['brəʊmi:n]	бром
C	carbon	['kɑ:bən]	углерод
Ca	calcium	['kælsɪəm]	кальций
Cd	cadmium	['kædmɪəm]	кадмий
Ce	cerium	['sɪərɪəm]	церий
Cf	californium	[ˌkælə'fɔ:nɪəm]	калифорний
Cl	chlorine	['klɔ:ri:n]	хлор
Cm	curium	['kjʊərɪəm]	кюрий
Co	cobalt	['kəʊbɔ:lt]	кобальт
Cr	chromium	['krəʊmɪəm]	хром
Cs	c(a)esium	['si:zɪəm]	цезий
Cu	copper	['kɒpə]	медь
Dy	dysprosium	[dɪs'prəʊzɪəm]	диспрозий
Er	erbium	['ɜ:bɪəm]	эрбий
Es	einsteinium	[aɪn'staɪnɪəm]	эйнштейний
Eu	europium	[ju: 'rəʊpɪəm]	европий
F	fluorine	['flʊəri:n]	фтор
Fe	iron	['aɪən]	железо
Fm	fermium	['fɜ:mɪəm]	фермий

Fr	francium	[ˈfrænsɪəm]	францій
Ga	gallium	[ˈgælɪəm]	галлій
Gd	gadolinium	[ˌgædəˈlɪnɪəm]	гадолиній
Ge	germanium	[dʒɜ: ˈmeɪnɪəm]	германій
H	hydrogen	[ˈhaɪdrədʒən]	водород
He	helium	[ˈhi:lɪəm]	гелій
Hf	hafnium	[ˈhæfnɪəm]	гафній
Hg	mercury	[ˈmɜ:kjʊrɪ]	ртуть
Ho	holmium	[ˈhəʊlmɪəm]	гольмій
I	iodine	[ˈaɪədi:n]	йод
In	indium	[ˈɪndɪəm]	индій
Ir	iridium	[ɪˈrɪdɪəm]	иридій
K	potassium	[pəˈtæsɪəm]	калій
Kr	krypton	[ˈkrɪptɒn]	криптон
Ku	kurchatovium	[ˌkɜ:tʃəˈtəʊvɪəm]	курчатовий
La	lanthanum	[ˈlænθənəm]	лантан
Li	lithium	[ˈlɪθɪəm]	літій
Ln	lawrencium	[lɔˈrensɪəm]	лоуренсій
Lu	lutecium	[lʊˈti:ʃəm]	лютецій
Md	mendelevium	[ˌmendəˈli:vɪəm]	менделевий
Mg	magnesium	[mægˈni:zjəm]	магній
Mn	manganese	[ˌmængəˈni:z]	марганец
Mo	molybdenum	[məˈlɪbdənəm]	молибден
N	nitrogen	[ˈnaɪtrədʒən]	азот
Na	sodium	[ˈsəʊdɪəm]	натрій
Nb	niobium	[naɪˈəʊbɪəm]	ніобій
Nd	neodymium	[ˌni:əʊˈdɪmɪəm]	неодим
Ne	neon	[ˈni:ən]	неон
Ni	nickel	[nɪkl]	никель
No	nobelium	[nəʊˈbi:lɪəm]	нобелій
Np	neptunium	[nepˈtju:nɪəm]	нептуній
Ns	nielsbohrium	[ni:lsˈbɔ:nəm]	нильсборій
O	oxygen	[ˈɒksɪdʒən]	кислород
Os	osmium	[ˈɒzmɪəm]	осмій
P	phosphorus	[ˈfɒsfərəs]	фосфор
Pa	protactinium	[ˌprəʊtækˈtɪnɪəm]	протактиній
Pb	lead	[led]	свинец
Pd	palladium	[pəˈleɪdɪəm]	паллади́й
Pm	promethium	[prəʊˈmi:θɪəm]	прометій
Po	polonium	[pəˈləʊnɪəm]	полоній
Pr	praseodymium	[ˌpreɪzɪəʊˈdɪmɪəm]	празеодим
Pt	platinum	[ˈplætɪnəm]	платина
Pu	plutonium	[plu: ˈtəʊnɪəm]	плутоній
Ra	radium	[ˈreɪdɪəm]	радій

Rb	rubidium	[ruˈbɪdɪəm]	рубидий
Re	rhenium	[ˈriːnɪəm]	рений
Rh	rhodium	[ˈrəʊdɪəm]	родий
Rn	radon	[ˈreɪdɒn]	радон
Ru	ruthenium	[ruˈθiːnɪəm]	рутений
S	sulphur	[ˈsʌlfə]	сера
Sb	antimony	[ˈæntɪmənɪ]	сурьма
Sc	scandium	[ˈskændɪəm]	скандий
Se	selenium	[səˈliːnɪəm]	селен
Si	silicon	[ˈsɪlɪkən]	кремний
Sm	samarium	[səˈmeərɪəm]	самарий
Sn	tin	[tɪn]	олово
Sr	strontium	[ˈstrɒntɪəm]	стронций
Ta	tantalum	[ˈtæntələm]	тантал
Tb	terbium	[ˈtɜːbɪəm]	тербий
Tc	technetium	[tekˈniːʃɪəm]	технеций
Te	tellurium	[teˈlʊərɪəm]	теллур
Th	thorium	[ˈθɔːrɪəm]	торий
Ti	titanum	[taɪˈteɪnjəm]	титан
Tl	thallium	[ˈθælɪəm]	таллий
Tm	tullium	[ˈtʌlɪəm]	тулий
U	uranium	[jʊəˈreɪnɪəm]	уран
V	vanadium	[vəˈneɪdɪəm]	ванадий
W	tungsten	[ˈtʌŋstən]	вольфрам
Xe	xenon	[ˈziːnɒn]	ксенон
Y	yttrium	[ˈɪtrɪəm]	иттрий
Yb	ytterbium	[ɪˈtɜːbɪəm]	иттербий
Zn	zinc	[zɪŋk]	цинк
Zr	zirconium	[zɜːˈkəʊnɪəm]	цирконий

III

Word-building

В английском языке **словопроизводство** (derivation), т. е. образование одного слова из другого, является самым распространенным способом образования слов.

Образование одного слова из другого производится следующими способами.

1. Без изменения произношения и написания слова:

у существительных и глаголов:

attack — атака	to **attack** — атаковать
play — игра	to **play** — играть
load — нагрузка	to **load** — нагружать

у прилагательных и глаголов:

close — близкий	to **close** — сближаться
warm — теплый	to **warm** — нагревать
last — последний	to **last** — продолжаться, длиться
slow — медленный	to **slow** — замедлять(ся)
loose — свободный	to **loose** — освобождать, ослаблять

у наречий и глаголов:

slow — медленно	to **slow** — замедлять(ся)
double — вдвое	to **double** — удваивать(ся)

В некоторых случаях — *у нескольких частей речи*:

light — светлый	**light** — свет	to **light** — зажигать, освещать
slow — медленный	**slow** — медленно	to **slow** — замедлять(ся)

2. При помощи изменения места ударений:

ˈ**progress** — прогресс, развитие	to **proˈgress** — прогрессировать, развиваться
ˈ**increase** — рост, увеличение	to **inˈcrease** — увеличиваться
ˈ**decrease** — уменьшение; спад	to **deˈcrease** — уменьшать(ся)
ˈ**object** — объект, цель	to **obˈject** — возражать, протестовать
ˈ**protest** — протест	to **proˈtest** — протестовать

3. При помощи аффиксов (префиксов и суффиксов)

1) Наиболее употребительные префиксы:

UN-

— имеет отрицательное значение, присоединяется к прилагательным:

able — способный
unable — неспособный
equal — равный
unequal — неравный
known — известный
unknown — неизвестный
satisfactory — удовлетворительный
unsatisfactory — неудовлетворительный

— присоединяется к глаголам, меняя их значение на противоположное:

to balance — уравновешивать
to unbalance — выводить из равновесия
to block — преграждать; задерживать
to unblock — открывать; устранять препятствие
to brace — обхватывать, скреплять
to unbrace — ослаблять, расслаблять
to clasp — сжимать
to unclasp — разжимать; выпускать
to cover — закрывать, накрывать
to uncover — открывать, раскрывать
to link — соединять, смыкать
to unlink — разъединять, размыкать

DIS-

— образует глаголы, имеющие значение обратного действия, уничтожения качества или свойства; существительные со значением отсутствия, лишения чего-л.; прилагательные, обозначающие противоположное качество или его отсутствие:

to join — соединять
to disjoin — разъединять
to affirm — подтверждать; утверждать
to disaffirm — отрицать
to adjust — регулировать; настраивать
to disadjust — разрегулировать
armament — вооружение
disarmament — разоружение
charge — заряд
discharge — разряд
coloured — окрашенный
discoloured — изменивший цвет; обесцвеченный

— обозначает разделение, отделение, рассеивание, разложение на составные части:

dismiss — распускать
disperse — разгонять, рассеивать
dismemberment — расчленение, разделение на части
disengage — освобождать; выключать; выделять

MIS-

— образует глаголы и существительные со значением противоположности или неправильности:

adjustment — регулировка; установка
to misadjustment — неверная регулировка или установка

to apply — применять; использовать	to misapply — неправильно использовать; злоупотреблять
to calculate — рассчитывать; считать	to miscalculate — ошибиться в расчете
citation — цитата	mis-citation — искаженная цитата
construction — строительство; конструкция; составление (*программы*)	misconstruction — неверное построение; неверное истолкование
handling — обращение	mishandling — неверное обращение (*с прибором*)
to measure — измерять	to mismeasure — неправильно измерять

IN-, IL-, IM-, IR-

— придают словам отрицательное значение:

ability — возможность; способность	inability — невозможность; неспособность
accurate — точный, правильный	inaccurate — неточный, ошибочный
accuracy — точность, аккуратность	inaccuracy — неточность, ошибка, погрешность (*прибора*)
correct — правильный	incorrect — неправильный
complete — завершенный, полный	incomplete — незавершенный, неполный
constant — постоянный, устойчивый	inconstant — непостоянный, неустойчивый
legal — правильный, законный	illegal — неправильный, незаконный
logical — логичный	illogical — нелогичный
limitable — ограниченный	illimitable — неограниченный
balance — равновесие	imbalance — неустойчивость, отсутствие равновесия
mobile — подвижный	immobile — неподвижный
movable — подвижный	immovable — неподвижный; стационарный
penetrable — проницаемый	impenetrable — непроницаемый; не поддающийся воздействию
permeable — проницаемый	impermeable — непроницаемый; плотный
regular — правильный; регулярный	irregular — неправильный; нерегулярный
radiation — радиация	irradiation — иррадиация, облучение
relation — связь, отношение	irrelation — несоответствие; отсутствие связи
reversible — обратимый	irreversible — необратимый

CO-

— означает общность, совместность действий, сотрудничество; взаимность (в существительных) или одинаковую степень чего-л. (в прилагательных):

factor — фактор	cofactor — совместно действующий фактор
to operate — действовать, работать	to co-operate — сотрудничать, взаимодействовать

RE-

— обозначает повторность действия, возвращение в прежнее состояние:

to act — действовать	to react — реагировать; действовать постоянно
adsorption — адсорбция	readsorption — резорбция
acting — действующий	reacting — реагирующий; реакционный
current — текущий, современный	recurrent — повторяющийся; текущий; периодический

OVER-

— встречается в различных частях речи; указывает на характер действия; на положение над чем-л. или нахождение сверху или за пределами чего-л., движение над чем-л. или через что-л., превышение, переход за пределы чего-л.; чрезмерность чего-то:

abundant — обильный; распространенный	overabundant — избыточный
action — действие	over-action — сверхактивность
balance — равновесие	overbalance — перевес; избыток
charge — заряд	overcharge — перегрузка; перезаряд (эл.)
delicate — тонкий; (высоко)чувствительный	overdelicate — сверхчувствительный
proportion — пропорция, соотношение; часть, доля	overproportion — диспропорция; избыточное содержание
work — работа	overwork — перегрузка, перенапряжение

INTER-

— обозначает взаимодействие, взаимовлияние:

to act — действовать	to interact — взаимодействовать; воздействовать, влиять
atomic — атомный	interatomic — межатомный
axial — осевой	interaxial — межосевой
to change — менять	to interchange — переставлять; обменивать(ся); чередовать(ся)
communication — связь	intercommunication — взаимосвязь
current — текущий	intercurrent — случайный; промежуточный, интеркуррентный

face — поверхность
interface — поверхность раздела; граница

to flow — течь
to interflow — сливаться, смешиваться

link — связь
interlink — связующее звено

mediate — опосредованный; промежуточный
intermediate — промежуточное (*соединение*), полупродукт

mixture — смесь
intermixture — примесь

polymerization — полимеризация
interpolymerization — сополимеризация

to work — работать; действовать
to interwork — оказывать взаимное воздействие, взаимодействовать

OUT-

— образует: — существительные со значением расположения вне границ, пределов чего-л., занятия, пребывания вне чего-л., выхода, исхода;

to come — приходить
outcome — результат

flow — поток; течение
outflow — вытекание; утечка; вытекшее количество

throw — бросок
outthrow — выброс; выпуск

— прилагательные со значением находящегося, расположенного вне чего-л., направляющегося или направленного куда-л.;

to date — датировать
outdated — устарелый

to lie — лежать; находиться
outlying — удаленный; далекий

— глаголы со значениями действия, направленного наружу, вовне, а также со значениями превосходства или превышения:

to balance — быть в равновесии, уравновешивать
to outbalance — превосходить; перевешивать

to wear — носить
to outwear — устаревать

to weigh — весить
to outweigh — превосходить в весе

2) Наиболее употребительные суффиксы существительных:

-ER, -OR

— образуют существительные со значением профессии, действующего лица, орудия действия, национальности:

to absorb — поглощать; всасывать
absorber — поглотитель, абсорбционный аппарат

to accelerate — ускорять; разгонять, увеличивать скорость
accelerator — ускоритель, акселератор

to boil — кипятить
boiler — паровой котел; реторта

to boost — поднимать; повышать
booster — усилитель; промежуточный детонатор; ракетоноситель

to distribute — распределять; разделять; классифицировать
distributor — распределительное устройство; распределитель

to invent — изобретать; создавать
inventor — изобретатель

to rub — тереть	rubber — резина, каучук
to test — испытывать, ставить опыт	tester — испытатель; лаборант
to vaporize — испарять, выпаривать	vaporizer — испаритель

-ENT, -ANT

— образуют существительные:

to absorb — поглощать; всасывать	absorbent — поглотитель, абсорбент
to assist — помогать, ассистировать	assistant — помощник, ассистент
to dessicate — высушивать; терять влажность	dessicant — сиккатив
to deterge — очищать; мыть	detergent — моющее, детергентное средство
to depend — зависеть	dependent — зависимый
to equivalence — эквивалентность	equivalent — эквивалент
to react — реагировать	reagent — реагент

-ION, -SION, -TION

— образуют существительные, обозначающие действие или процесс, состояние или качество, конкретный результат действия:

to act — действовать	action — действие
to apprehend — понимать, постигать	apprehension — концепция, понятие
to collide — сталкиваться	collision — столкновение
to attract — притягивать	attraction — притяжение; столкновение
to crystallize — кристаллизовать(ся)	crystallization — кристаллизация
to direct — направлять; руководить	direction — направление; указание, инструкция
to ionize — ионизировать	ionization — ионизация
to react — реагировать	reaction — реакция

-ANCE, -ENCE

— образуют отвлеченные существительные, обозначающие действие, состояние, качество, а также некоторые конкретные существительные:

to assist — помогать, ассистировать	assistance — помощь; содействие
to disturb — нарушать равновесие покоя; движения	disturbance — нарушение; повреждение
to depend — зависеть	dependence — зависимость
to differ — различаться, отличаться	difference — разница; различие
to ignore — не обращать внимания; пренебрегать	ignorance — невежество; незнание

-URE

— образует существительные, обозначающие процесс, действие и его результаты:

to fail — терпеть неудачу, поражение	failure — неудача, провал
to press — давить	pressure — давление

— встречается также в существительных, обозначающих действие; процесс, состояние, качество или результат действия:

culture — культура	temperature — температура
fracture — разрыв	structure — структура
nature — природа	literature — литература

-NESS

— образует в основном существительные от прилагательных с отвлеченным значением качества:

kind — добрый	kindness — доброта
useful — полезный, пригодный	usefulness — полезность, пригодность
dark — темный	darkness — темнота
quick — быстрый	quickness — быстрота

-TH

— образует существительные от глаголов и прилагательных, обозначающие действие и его результат:

to grow — расти	growth — рост, развитие
strong — сильный	strength — сила
true — истинный; точный; настоящий	truth — правда; точность; соответствие
long — длинный	length — длина, протяженность
deep — глубокий	depth — глубина

-ISM

— образует существительные с отвлеченным значением:

communism — коммунизм	mechanism — механизм
capitalism — капитализм	criticism — критика
realism — реализм	

-DOM

— образует существительные с отвлеченным значением:

wise — мудрый	wisdom — мудрость
free — свободный	freedom — свобода

-TY, -ITY

— образуют абстрактные существительные, обозначающие состояние, положение, качество, свойство:

able — способный	ability — способность
flexible — гибкий, эластичный	flexibility — гибкость, эластичность
special — особый; специальный	speciality — специальность
superior — лучший; превосходный	superiority — превосходство

-ICS

— встречается в названиях ряда наук:

physics — физика	economics — экономика
mathematics — математика	electronics — электроника
dialectics — диалектика	dynamics — динамика
tactics — тактика	

-ICITY

— образует отвлеченные существительные, обозначающие свойство, качество или состояние:

atomic — атомный	atomicity — атомность, валентность
electric — электрический	electricity — электричество
specific — особый, точный	specificity — специфичность

-ING

— образует существительные:

to fog — затуманивать(ся)	fogging — потускнение; затемнение; вуаль
to heat — нагревать	heating — нагревание; накаливание
to point — указывать	pointing — указание; прицеливание
to poison — отравлять	poisoning — отравление
to freeze — замораживать	freezing — замораживание

-MENT

— образует существительные, обозначающие действие и его результат, состояние:

to move — двигаться	movement — движение
to develop — развивать	development — развитие
to equip — оборудовать	equipment — оборудование
to achieve — достигать	achievement — достижение
to measure — измерять	measurement — измерение

3) Наиболее употребительные суффиксы прилагательных:

-ABLE, -IBLE

to answer — отвечать	answerable — ответственный; соответствующий
to move — двигаться	movable — подвижный; переносной
sense — чувство	sensible — чувствительный
flex — сгибать, гнуть	flexible — подвижный; гибкий
to limit — ограничивать	limitable — ограниченный

-ANT, -ENT

to resist — сопротивляться	resistant — стойкий, прочный
to differ — различать, отличаться	different — различный; отличающийся
to depend — зависеть	dependent — зависимый

-IVE:

to act — действовать	active — активный
to create — творить	creative — творческий
to decide — решать	decisive — решающий
to demonstrate — демонстрировать; показывать	demonstrative — наглядный, доказательный

-FUL

— обозначает наличие качества:

peace — мир	peaceful — мирный
care — забота	careful — заботливый; осторожный; тщательный

-LESS

— обозначает отсутствие качества:

wire — провод, проволока	wireless — беспроволочный; беспроводной
use — польза	useless — бесполезный
life — жизнь	lifeless — безжизненный

-ISH

— обозначает неполную степень качества:

blue — голубой	bluish — голубоватый
white — белый	whitish — беловатый
cold — холодный	coldish — довольно холодный; холодноватый

-Y

— указывает на степень качества или склонность к чему-то:

dirt — грязь	dirty — грязный
ice — лед	icy — ледяной
chill — холод	chilly — холодный

-AL

emotion — эмоция	emotional — эмоциональный
centre — центр	central — центральный
technique — техника; метод	technical — технический

-IC

atom — атом	atomic — атомный
economy — экономика	economic — экономный; экономический
history — история	historic — исторический
system — система	systematic — систематический

-OUS

danger — опасность	dangerous — опасный
poison — яд	poisonous — ядовитый, отравляющий
glory — слава	glorious — славный

4) Наиболее употребительные суффиксы глаголов:

-FY

electricity — электричество	to electrify — электризовать, электрифицировать
quality — качество	to qualify — квалифицировать
class — класс	to classify — классифицировать
pure — чистый	to purify — очищать

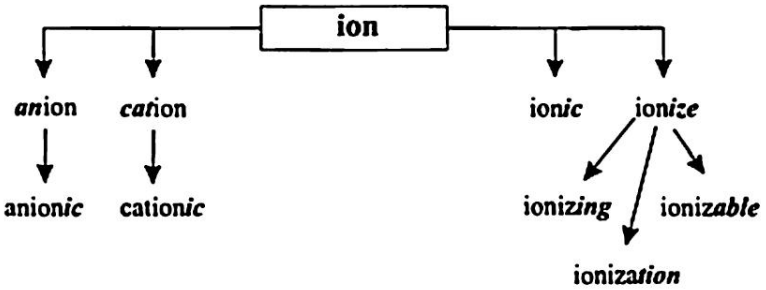
-IZE

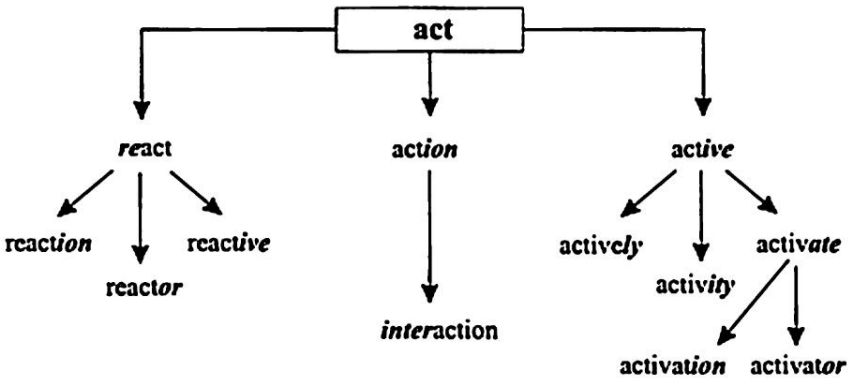
equal — равный	to eqalize — сравнять, уравнять
real — явный, действитель-ный	to realize — понимать
economy — экономика	to economize — экономить

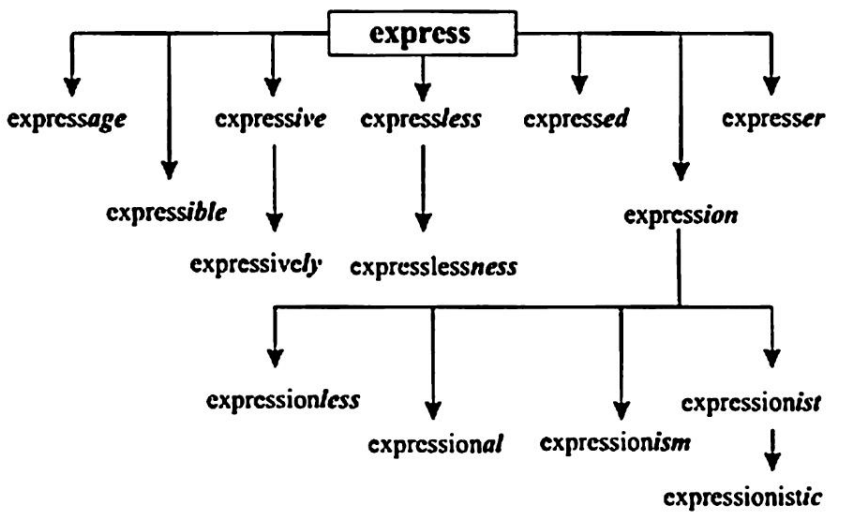
-EN

deep — глубокий	to deepen — углублять
fast — быстрый	to fasten — убыстрять
short — короткий	to shorten — укорачивать
wide — широкий	to widen — расширять

Общие схемы образования производных слов

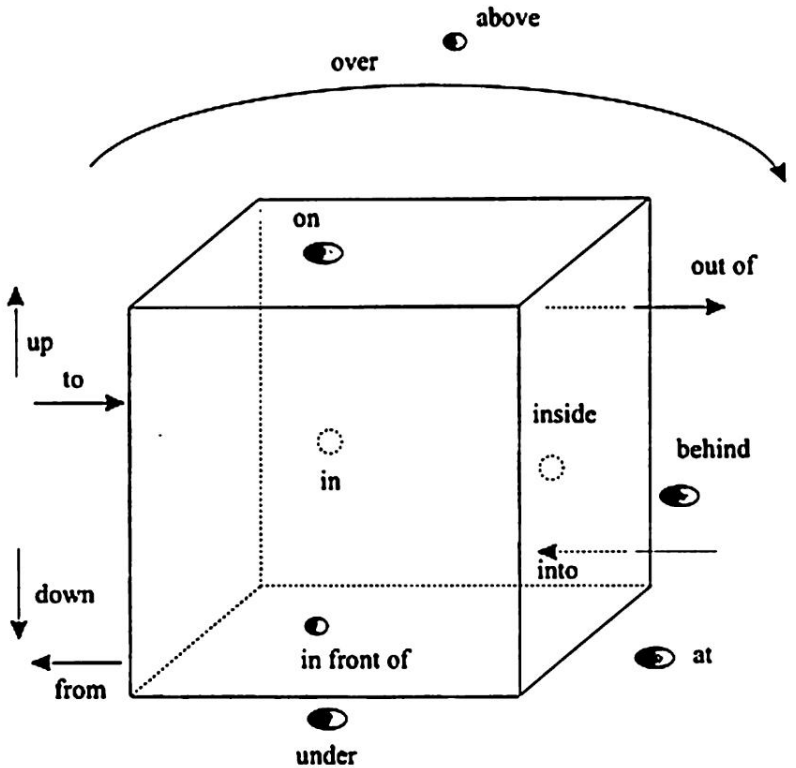






IV

Prepositions of Place and Direction



V

Irregular Verbs

arise	arose	arisen	возникать
be	was, were	been	быть, являться; находиться
bear	bore	borne	нести; переносить; выносить
become	became	become	становиться
begin	began	begun	начинать(ся)
bind	bound	bound	связывать
break	broke	broken	ломать; порывать; разрушать
bring	brought	brought	приносить; доставлять
build	built	built	строить; создавать
burn	burnt	burnt	гореть; сжигать; жечь
buy	bought	bought	покупать
catch	caught	caught	схватить; поймать; уловить
choose	chose	chosen	выбирать
come	came	come	приходить; приезжать
cost	cost	cost	стоить
cut	cut	cut	резать; сокращать; снижать
deal	dealt	dealt	распределять
do	did	done	делать
draw	drew	drawn	тащить; извлекать
drink	drank	drunk	пить
drive	drove	driven	управлять; приводить в движение; ехать
eat	ate	eaten	есть
fall	fell	fallen	падать

feel	felt	felt	чувствовать
fight	fought	fought	бороться
find	found	found	находить; оказываться
fly	flew	flown	летать; лететь
forget	forgot	forgotten	забывать
freeze	froze	frozen	замерзать; замораживать; застывать
get	got	got	получать; добираться; становиться
give	gave	given	давать; придавать
go	went	gone	идти; двигаться; ехать
grow	grew	grown	расти; выращивать; становиться
have	had	had	иметь
hear	heard	heard	слышать; услышать
hold	held	held	держать; вмещать; проводить (*мероприятие*)
keep	kept	kept	держать; сохранять; продолжать
know	knew	known	знать
lay	laid	laid	класть; положить
lead	led	led	вести; руководить
learn	learnt	learnt	учить(ся); узнавать
leave	left	left	уходить, уезжать; оставлять
let	let	let	позволять
lie	lay	lain	лежать
light	lit	lit	зажигать; освещать
lose	lost	lost	терять; утратить
make	made	made	делать
mean	meant	meant	означать; значить; подразумевать
meet	met	met	встречать; удовлетворять
overcome	overcame	overcome	преодолевать
pay	paid	paid	платить
put	put	put	класть; помещать
read	read	read	читать
ring	rang	rung	звонить

rise	rose	risen	повышать(ся)
run	ran	run	бегать; работать; управлять
say	said	said	говорить; сказать
see	saw	seen	видеть
sell	sold	sold	продавать
send	sent	sent	посылать
set	set	set	ставить; устанавливать
shed	shed	shed	проливать; лить
show	showed	shown	показывать
shut	shut	shut	закрывать; перекрывать
sit	sat	sat	сидеть; заседать
sleep	slept	slept	спать
slide	slid	slid	скользить
speak	spoke	spoken	говорить; разговаривать
spend	spent	spent	тратить; проводить (*время*)
spread	spread	spread	распространяться; простираться
stand	stood	stood	стоять; выдерживать
strike	struck	struck	ударять; поражать
swim	swam	swum	плавать
take	took	taken	брать; взять
teach	taught	taught	учить; обучать
tell	told	told	говорить; рассказывать; сообщать
think	thought	thought	думать; полагать
understand	understood	understood	понимать
win	won	won	выигрывать; победить
write	wrote	written	писать

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